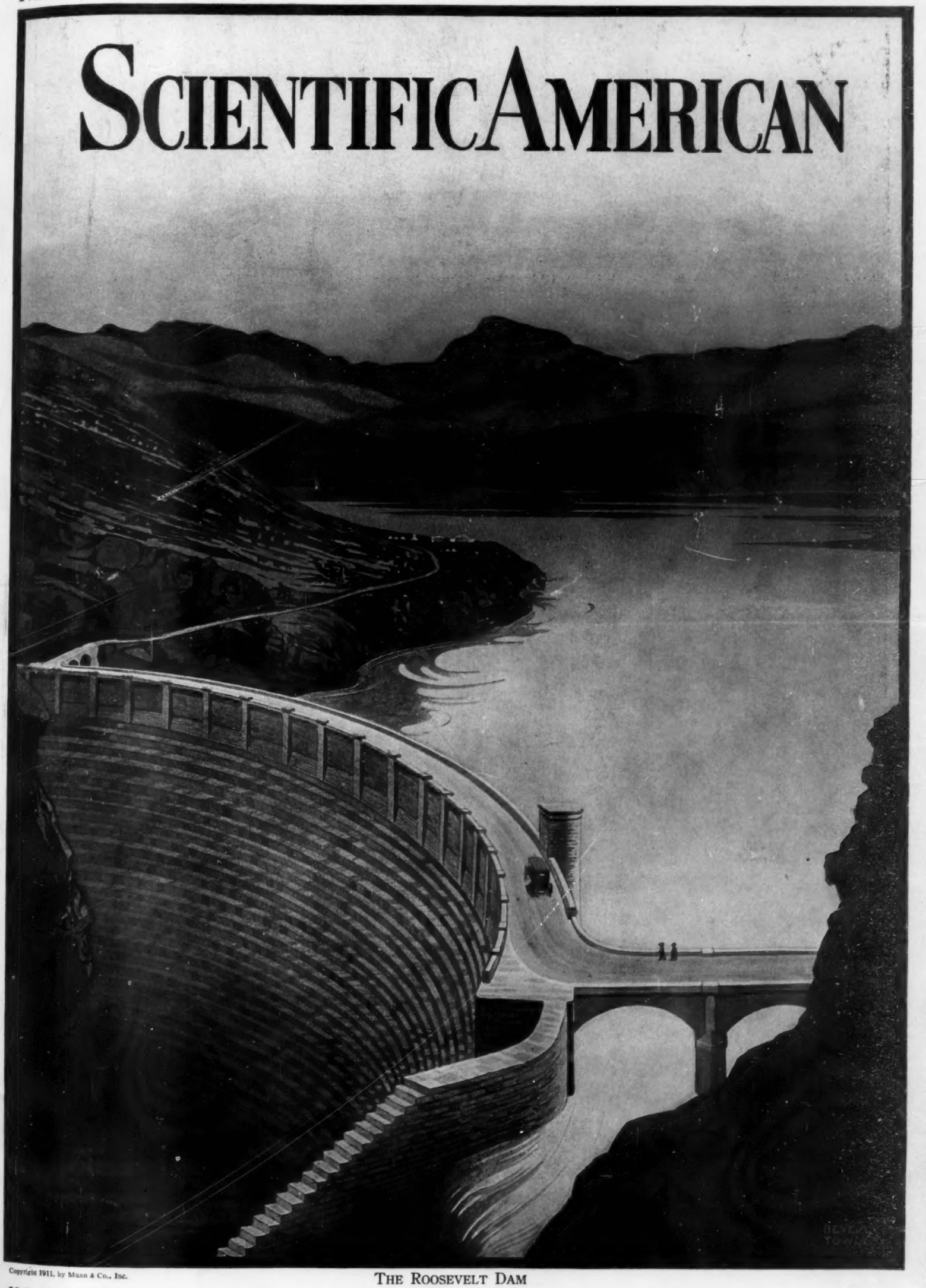
CONSERVATION

Conservation looks to the planned, orderly, and complete development of a greater Nation, a happier people, in a Continent saved from Waste.—*Gifford Pinchot.*

SCIENTIFIC AMERICAN



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THE ROOSEVELT DAM

Vol. CV. No. 7
August 12, 1911

Munn & Co., Inc., Publishers
New York, N. Y.

Price
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The Engine that Supplanted the Finest in the World

The Stearns-Knight marks a new era in American automobile design

ACKNOWLEDGED AND ADOPTED
By DAIMLER in England
By MERCEDES in Germany

Stearns

THE ULTIMATE CAR
(Knight Type Motor)

ACKNOWLEDGED AND ADOPTED
By PANHARD in France
By MINERVA in Belgium

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Before you invest in a new car examine the Stearns-Knight. See for yourself the engine that is revolutionizing motordom—that has been adopted by the European leaders in automobile design. The years of experience of these builders—proven by further tests and developments in the Stearns factory—have led us to the adoption of this master motor.

New to America, the Knight is not a new engine. For years it has been in use abroad. Over half a million has been spent in perfecting it. We ourselves have expended over $100,000 to offer a car embodying the genius of the world's greatest designers.

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The Master Motor

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Then judge it by its simplicity. Remember that although it is a 4-cycle motor there are no valves to grind. Remember that there is nothing that can get noisy. And remember that the qualities which you most admire will only improve with use.

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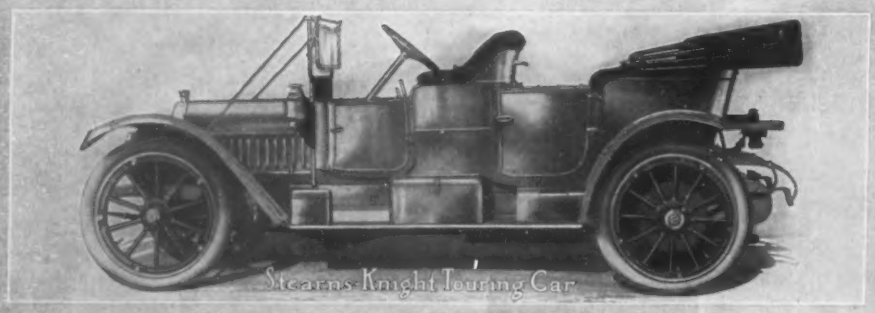
These booklets and "A Ride With The Chief"— telling the story of the Stearns-Knight in the words of our Chief Engineer—will be mailed upon request. Simply fill out the coupon and mail it to us.



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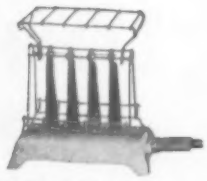
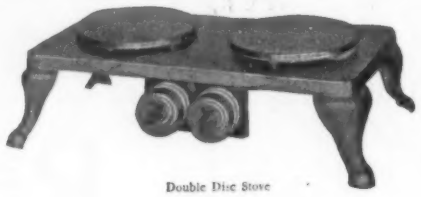
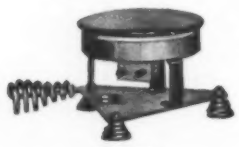

Radiant Toaster, with rack

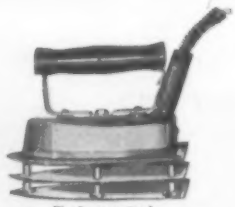
Electric Samovar

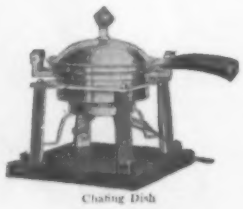

Double Disc Stove


Disc Stove

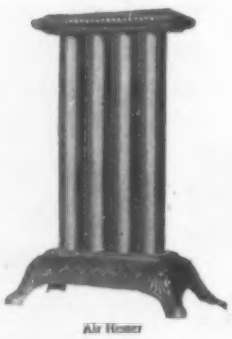
Coffee Percolator

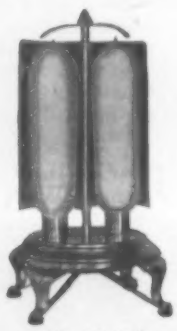
Four Quart Tea Kettle

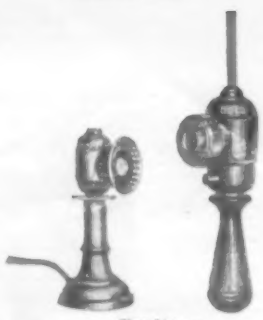

Flat Iron on stand


Chafing Dish

Water Heater


Air Heater


Luminous Radiator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SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 7.] NEW YORK, AUGUST 12, 1911 [10 CENTS A COPY $3.00 A YEAR

Lookout station for forest fires in a national forest.

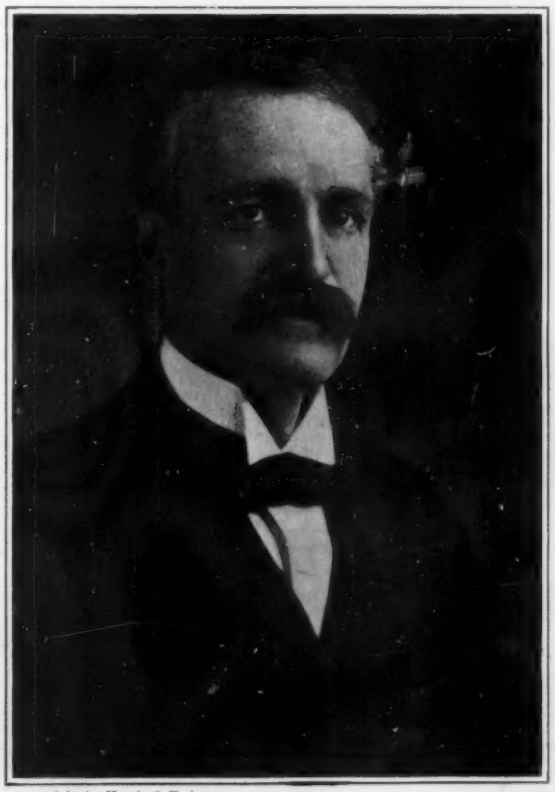
The Conservation of the Forests

A National Duty to Protect the 80 Per Cent of Standing Timber Now in Private Hands

By the Hon. Gifford Pinchot, Ex-Chief Forester

FOUR-FIFTHS of the timber in the United States is in private hands. Its preservation depends absolutely upon what the owners choose to do with it. The owner of any part of it may allow his trees to stand uncut; or he may cut them under the prevailing method of destructive lumbering, so that a new forest will not replace the old; or he may consider his timber land as a permanent factory of wood and apply the principles of forestry. This last is what the public welfare requires that he should do, but less than two per cent of the privately held timber lands of the United States are now being conservatively handled. With the threat of a timber famine so clearly before us that no man can deny the danger, we are treating four-fifths of our timber in the way best calculated to bring on that famine with the least possible delay and in the most aggravated form.

It is by no means wholly the fault of private timber land owners that they do not practise forestry. To practice forestry is to engage in a manufacturing business, the product of which is wood. Now no manufacturing business can succeed unless the products of the factory will bring more in the market than they cost to produce. This is not generally true to-day of the product of the forests. The enormous accumulation of raw material (standing timber) which cost us of this generation nothing to grow in the first place, is the chief reason why the finished product (lumber, etc.) sells to-day in the United States for less than it would cost to grow, harvest, and manufacture it. This is not true in France, Germany, or other countries where forestry is practised. Under the laws and economic conditions which there obtain, a timber land owner who grows wood for the market makes a reasonable interest on his money.



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Hon. Gifford Pinchot, ex-chief forester.

Forestry, like any other industry, must become financially attractive before business men will take it up, and several basic conditions must be supplied before it can become so. For example, there must be a reasonable security against forest fires. As long as there is excessive danger that the investment may go up in smoke, the attractiveness of a long-time investment in growing wood must be very seriously reduced. There must be reasonable taxation, under which there will be a fair chance to make the business pay. The land upon which the trees grow should be taxed annually; but the growing forest crop itself should be taxed only when it is ripe for cutting. Other crops, like corn, pay but one tax before harvest. Under present methods of taxation the timber crop may pay fifty or one hundred.

There must be fairly uniform conditions imposed upon all competitors in the same market. While the difference in cost between conservative lumbering and ordinary destructive lumbering is but small, it is often sufficient to give one of two competitors control over a market which both are seeking. Thus if a State should require its lumbermen to burn their slashing, protect young growth, and generally to keep their forests in productive condition, while the State which imposed such conditions would be at a great permanent advantage, the lumbermen who were obliged to practise them would be at a slight and temporary disadvantage, as compared with those of a neighboring State which did not require these precautions.

Since we must have lumber, it is clear that

(Continued on page 137.)

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, AUGUST 12, 1911

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Sin of National Improvidence

AMONG the many questions of national significance which have recently been brought to the public attention, there are few which compare in importance with that of conservation.

Not many thoughtful Americans will deny that extravagance is one of our distinctive national faults. At the first thought, it may seem strange that the nation which has sprung from the thrifty settlers who founded Plymouth and Jamestown, and were schooled in the rough adversities of an unusually strenuous pioneer life, should have developed that very improvidence which the circumstances surrounding the life of the early settlers strictly forbade. Not alone in the beginnings of the nation, but for many a decade of its early existence, the conditions of life were exceedingly hard. Never, surely, did a race of men so literally earn its bread by the sweat of its brow as those resolute pioneers, who had to coax the means of life from the rock-encumbered hills and valleys of New England, or endure the prodigious toil of clearing away primeval forests before they could lay bare a patch of arable land from which to raise the food and feed for man and beast.

It was in later years, when the van of pioneer conquest had been pushed out into the rich and unobstructed prairie lands of the West, that the American people began to realize with what lavish abundance nature stood ready to pour forth her treasures. When the cattle multiplied upon a thousand hills and the crops burst forth in luxurious abundance from the virgin soil, the pressing need for careful husbandry of resources was no longer felt. Hence it has come about that nature herself is largely responsible for that later extravagance, which led the American people to squander resources which they have come to regard and speak of as "practically inexhaustible."

Unfortunately, the habits learned on the farm have been carried into those great industrial activities, whose magnitude is one of the wonders of our modern life. If the riches of the soil were "inexhaustible," so also seemed to be those of the forest, of the mine, and of the rivers and lakes and seas with their teeming millions. Hence it has come about that in our effort to gather only the riches which are immediately and easily accessible, we have been using up nature's storehouse of raw material, ruthlessly destroying or letting go to waste thousands of square miles of forest and millions of tons of coal and precious minerals. Year after year crops have been sown upon the once virgin lands, until, in sheer exhaustion, they have refused to render the plenteous yield of former years, or even to yield any crops whatsoever—at least until the husbandman shall have restored some portion of those nutritive elements which are necessary to germination, growth and full fruition.

We have all heard and read a great deal during the past few years about this subject of conservation; but it is a question whether many people have any just conception of how great has been the wicked waste of the past and how pressing is the need for future economy. The present issue of the SCIENTIFIC AMERICAN is published in the hope that it may put this whole question in its true light, and show exactly what are the present conditions and what are the methods which have been pursued by the Federal Government, in the effort to repair the damage which has been done, and properly conserve those natural resources upon which not only the prosperity, but the very life of the nation depends. The articles are written by men who, because of their position at the heads of the several departments which are devoted to conservation, are possessed of a full knowledge of the facts and are qualified to state the case with authority. The conservation number is issued in the belief that it will not only answer a thousand questions which have arisen in the mind of the American public, but will also make clear the necessity for a most earnest and intelligent co-operation with the government in this great national work.

The Hand That Wrecks the Cradle

IN a recent editorial in these columns, we spoke of the work which the modern eugenist is doing to arouse the public conscience not only to the possibilities of improving the human race by proper selection of parent types, but to the far more vital matter of mere self preservation. We called attention to Pearson's statement that 25 per cent of the present generation is producing 50 per cent of the next; that imbeciles, paupers, criminals and defectives were reproducing faster than manufacturers, merchants, lawyers and physicians; that, in a word, if the present form of society is to continue, something must be done to prevent the perpetuation of defective classes. To those readers who may take more than a casual interest in the subject, we commend the reading of Prof. William E. Kellicott's "Social Direction of Human Evolution," a book which presents in a popular and yet authoritative manner the dangers that beset society.

That these dangers are not mere dreams, that heredity does play the major part in the prevention of desirable and undesirable classes alike, is only too easily demonstrated in order to drive home the necessity of a careful study of human heredity. We have only to cite Poellmann's study of a family established by two daughters of a woman drunkard, who in five or six generations produced all told 834 descendants, of whom over 700 were professional beggars, inmates of almshouses, criminals and incompetents of various degrees, and to contrast with that degenerate family the 1,394 descendants of Jonathan Edwards, most of whom occupied distinguished positions in educational institutions, in the diplomatic service, in political life, in commercial affairs, and in literature.

Environment plays but a small part in this process of conscious race improvement. Free public libraries, clean houses, modern sanitation cannot correct bad blood. Slums, sweatshops and dirt are bad, not because they breed criminals, but because they may kill off classes which, if nourished, might become strong and healthy stocks. What is wanted is a more painstaking and scientific study of the germ plasm that develops a healthy or unhealthy strain, rather than more asylums and prisons for the correction and punishment of offenders. A philanthropist who will wisely donate to that cause the funds which would otherwise find their way to the coffers of charitable institutions should earn everlasting fame. Greater than any political issue, greater than the building of more universities and libraries, greater even than the abolition of standing armies, is any movement which has for its object the direct improvement of the human race.

The sociologist has had his day. His statistics of people who are ill fed and ill housed, can serve no other purpose than that of indicating the need of better accommodations for the poorer classes in the effort to uplift them. It is to the biologist to whom society must turn—the man who can definitely point out why this or that strain is undesirable, why this family should not be married into, because of its questionable ancestry, why that stock is desirable because from it there had sprung men and women of genius.

Able work in this direction is now being done in England under the guidance of Prof. Karl Pearson of the Eugenics Laboratory of the University of London, and in America by the Committee on Eugenics of the American Breeders' Association, of Cold Spring Harbor, New York. Only a beginning has been made, but a beginning that has shown that behind the phrase "race suicide" which was bandied about a few years ago, there looms a danger far greater than most of us realize. It is becoming increasingly evident that good blood means not simply descent from an aristocratic race, but descent from a race physically and mentally and morally strong.

When we consider that, according to the latest available census reports, there are among our 90,000,000 people at least 200,000 who are insane and feeble minded; 100,000 who are blind; 100,000 who are blind and deaf and dumb; 80,000 who are paupers in institutions, two-thirds of whom have children physically or mentally deficient; 100,000 prisoners, several hundred thousand more who ought to be prisoners; 23,000 juvenile delinquents in institutions; and 2,000,000 who are in hospitals, dispensaries, and "homes" of various kinds; and lastly, when we consider that this rough total of nearly 3,000,000 defectives is capable of transmitting its tainted protoplasm to the next generation, there is indeed room for the new science of race improvement, and room, too, above every asylum and prison portal, for Rentoul's epigrammatic utterance:

"The hand that wrecks the cradle wrecks the nation."

A Chemical Solution of Feldspar.

IT is a most humiliating fact that America must buy all her potassium salts from Germany—humiliating because they are absolutely necessary in renewing the fertility of our soils. Our farmers paid the Fatherland $8,000,000 last year for this one element, importing 160,000 tons of potassium chloride as well as large quantities of potassium sulphate.

Germany is very fortunate in possessing the wonderful Stassfurt deposits of mixed salts, for she has practically a monopoly of the potassium market of the world. Their government has recently given official sanction to an effort of a German trust to put up the price, although the stuff is cheaply mined. Here in America we have enormous deposits of phosphate rock and from various sources such as stockyards, Chili saltpeter, the air, etc., are assured unlimited nitrogen, but our crops demand, in addition to phosphorus and nitrogen, the third element potassium. In spite of the fact that we send $8,000,000 a year out of the country for potassium, we have enormous quantities of it at home in feldspar rock. The slow weathering of this rock makes some of it available for plant use in soluble form, and our unfertilized soils owe much to this fact. Heavy cropping, however, removes this necessary element faster than Nature prepares it in suitable form for plant use, and so arises the need of fertilizer to make good the loss.

The facts we must face then are these: Potassium chloride is quickly taken up by crops, but feldspar is too slowly available to maintain the fertility of the soil. Therefore our American problem is to make potassium chloride from our abundant feldspar by chemical means. When that is done cheaply we may snap our fingers at Germany, for we will have all our plant food at home. Even if such a process could not quite compete with the German salts at present prices the fact that we were prepared, if needs must, to make our own potassium chloride would be a wholesome restraint on exorbitant price raising. It is encouraging to every patriot to learn that the chemistry of this much-desired process has been fairly well developed. By heating finely ground feldspar with calcium chloride (a cheap by-product of soda making) and some limestone the potassium can be extracted as the soluble potassium chloride. The residue is suitable material to calcine further into cement. The cost at present is much too high, but the sale of the cement would reduce this. One ton of feldspar rock may yield 190 pounds of potassium chloride worth $4.50 and five or six barrels of cement worth as much more. In making our annual allowance for this fertilizer we would throw on the market 7,000,000 barrels of cement—at present we use 65,000,000.

The experts of the Tariff Board urge the appointment of a national commission of chemists, geologists, engineers and business men to work out the problem on a scientific and economic basis. There is more to it than chemistry alone. Not the least factor is the location of raw materials and transportation difficulties. We owe it to our economic independence to attack this question, not from individual business motives, but from motives of the purest patriotism.

Science for Its Own Sake

SIR JAMES DEWAR recently pointed out that the whole cost of a century's research of experiments at the Royal Institution has been only about $600,000. What an insignificant sum to pay for the benefits mankind had received from the splendid investigations of Young, Davy, Faraday, Tyndall, Dewar himself, and others, comments the London *Times*. Yet most of the labors of these men were carried out *honoris causa*, and not for immediate material benefit.

(Concluded from page 135.)

the duty to surround the industry of growing wood with such conditions as will make it attractive rests squarely upon the people of the United States. The penalty for shirking this duty is a famine of one of the three great raw materials: coal, iron, and wood.

The people, then, have obviously shirked some part of their duty by failing to make forestry easily practicable. The lumbermen of the United States, it is true, have received from the government more practical help toward the introduction of forestry than has ever been offered to the lumbermen of any other country. Information of all kinds, co-operation, and practical examples have all been supplied plentifully and well. The United States Forest Service has given encouragement and assistance to the lumber fraternity to a degree wholly without example in any other country.

As a nation, we have neglected to provide the conditions necessary for all this help to have its most useful effect, and the conditions for practical forestry created under our laws leave much to be desired. Still the government has been most generous to the lumbermen in very many respects. Thus under the land laws, which have been bad, and their administration, which has been worse, the lumbermen have acquired timber land very easily, and a great concentration of timber ownership has been allowed to grow up. According to the official figures of the Commissioner of Corporations one hundred and ninety-five owners now control forty per cent of the standing timber of the United States. Three corporations, the Weyerhaeuser Timber Company, the Southern Pacific Company, and the Northern Pacific Railway Company, with their subsidiary companies, have nearly eleven per cent of all our privately owned forests. Less than half a century ago, the government owned not less than three-fourths of the standing timber in the United States. To-day, only one-fifth of all standing timber is publicly owned, while four-fifths have passed into private ownership, together with the land upon which this timber stands.

The men who hold this land own it in fee simple. It is useless to expect that they will handle it in such a way as to reduce the amount of concentration. The whole trend of our commercial development is toward great combinations of property in all the fields of industry. It is worse than useless to imagine that the old days of unrestricted competition can be restored by any legal devices whatsoever, even if it were desirable to do so. The remedy for evils of this kind is not unrestricted competition, which it is perfectly obvious can never return, but government control and regulation of combinations, concentrations, and monopolies. Forestry is of such a nature that unrestricted competition between the owners of timber lands leads not to forest protection but to destruction and waste. Of all concentrations which exist, there is none in which government regulation is more essentially and immediately necessary than in the concentration of standing timber.

Trails and telephone lines are essential to protection of forests from fire.

AIDS TO FIRE PATROL

The denuded lands are privately owned, and have been logged under ordinary methods. The upper slope is on a national forest, and has been logged conservatively.

NATIONAL AND PRIVATE OWNERSHIP

Of late years lumbermen and foresters have been most friendly. The foresters have been listened to, encouraged, and assisted by the lumbermen, whose response to the foresters has been in many ways most gratifying. They have done everything that could have been expected of them, except to practise forestry. They profess themselves desirous of doing so. It is of the first importance to the nation that they should, and the time to begin is at once.

The great interstate concentration of timber land ownership has made clear the duty of the nation to interfere for the protection of the legitimate interests of us all, lumbermen included. Since the nation owns but a small fraction of the standing timber, and since the wise handling of all of that timber is essential for the future welfare of the country, there remains nothing for the people to do but to accept the situation and regulate the handling of private forest land.

There is nothing revolutionary in such a doctrine. The Swiss, a people far more democratic than ourselves, have long ago adopted it, and the Federal Government protects and regulates the forests necessary for the general welfare. In the Republic of France, this doctrine is one of the fundamental conceptions of government. There is obviously no more reason why an individual in the United States should be allowed to handle his own forests in a way to injure the public welfare than why he should be allowed to use his own property in a city so as to endanger the public health.

I am far from having any quarrel with the fullest exercise of State sovereignty over the forests within the boundaries of each State. But the problem of the forests, like the problem of the streams, is by its very nature an interstate affair. It may take long to work it out, but before we are through with it the regulation of the lumber industry in the interest of the public welfare must be and will be accomplished mainly by the nation itself.

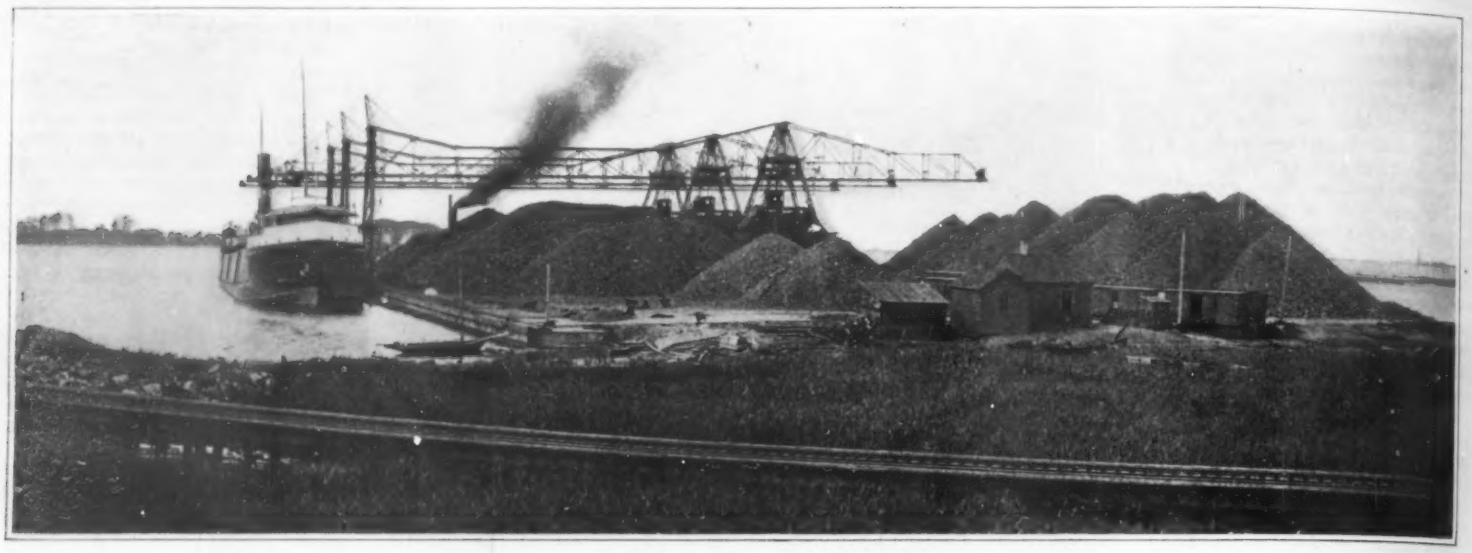
There are then two principal things to be done. First, the States and the nation must improve the conditions which now surround and retard the practice of forestry by private owners. Second, the destruction of our forests by the private owners of timber lands must be stopped. I anticipate with confidence that the lumbermen will give their powerful help in the task, but whether they do or not, the problem is far larger than anything except the nation itself, and the general welfare must control.

Young growth coming in on old burn was in a national forest and protected from fire.

THE RETURN OF THE FOREST

This forest has been cut without injury to young trees, left standing, which will produce good second crop.

A FACTORY OF WOOD



Unloading coal at a lake port.

The Use and the Waste of Our Coal Supply

At the Present Rate Coal may be Exhausted while the Nation is Yet Young

By Dr. Joseph A. Holmes, Director of the Bureau of Mines

THE habit of waste is one of the unfortunate inheritances of the 20th century American citizen. It is our most serious hinderance to the development of both individual and national efficiency. More than anything else, it stands in the way of the wise use or conservation of the resources, ample, present and future, supplies of which are essential to our individual and national welfare.

This fact is important enough to command attention when applied to products of the soil, of which we have new supplies each year; or to our forests of which each century may bring returns; or to the soils themselves to which the underlying rocks slowly yield new additions as by careless culture we permit the fertile surface to be eroded and carried off to the sea. It is still more important when applied to our mineral resources, of which we have but the one supply—which supply has required millions of years for its accumulation, and which supply at the present increasing rate of consumption may be exhausted while the nation is yet young; and especially when applied to our fuel resources, of which the portions used each day are completely destroyed.

And, yet, the very abundance, and supposed abundance, of our mineral resources has developed and encouraged the habit of waste. A legislator of many years' experience in national affairs, was recently quoted as saying in a public address: "Why, worry ourselves about a future coal supply when there is undiscovered coal enough in the Rocky Mountain regions to warm this nation for an indefinite future." Another of our "older statesmen" has in recent public utterance voiced the same view: "We have enough coal and to spare," he said, "for a thousand decades of our national history; therefore, we need not concern ourselves about the use, nor the waste of American fuel." And the average citizen has so long heard so much about the "exhaustless resources" of this country, that he is half way inclined to believe such statements.

It is only within the past few years that the real facts of the situation have impressed themselves upon us. The end of the coal supply in certain important centers is found to be already nearly in sight. The cold-blooded statistician studying the future in the light of the past, tells us that, if the increasing rate of consumption of the past century be continued in the future, our national coal supply may be exhausted within less than two hundred years. The States that first feel the effect of this fuel exhaustion, in spite of their larger supplies, will be those like Pennsylvania, West Virginia, Ohio, Illinois, and Iowa, located near great manufacturing and transportation centers, and upon whose supplies the largest drains are being made—both in the use and the waste of essential resources.

Be this all as it may, as to one fact and principle all thoughtful citizens must agree, namely, that while no one questions the right of each generation to use efficiently of this coal supply all it really needs, this right carries with it a sacred obligation—that no man and no generation of men shall waste that which is not needed for its actual use, and which, therefore, belongs to the nation.

Waste in Mining Coal.

The fact that the loss of coal in mining operations now approximates 250,000,000 tons per annum; or that we leave underground in such condition as to make its future recovery impracticable, half a ton for every

Removing coal from hold of lake steamer to a storage platform.

THE USE AND WASTE OF OUR COAL SUPPLY

ton of coal now brought to the surface, is a fact that commands serious consideration. And what makes a bad matter worse, is the fact that this coal left underground is often a menace to property by originating or harboring mine fires, and often a menace to life by developing supplies of explosive mine gases that may by falls or settling of roof be driven unexpectedly into the working parts of the mine, where open lights or other agencies may ignite it and cause a mine disaster.

In some mines from eighty to ninety per cent of the coal is brought to the surface. In many mines the recovery ranges from sixty to seventy-five per cent of the whole, while in some mines the recovery is from forty to sixty per cent. In some cases this loss consists mainly of the pillar coal left in place to support the roof while the other coal is being removed, and which pillar coal may be later not removed or only partially removed.

In addition to this pillar coal in many mines there is a "roof coal," or "rooster coal," or "top coal," and also a "bottom coal," which is also left underground because lower in quality or more expensive to mine.

Additional losses of coal coming from the pulverizing action of the drills and coal cutting machines (see photo), from the grinding of coal under the wheels of the mine cars (see photo); and from the sorting or screening and washing and general handling about the shaft and tipple. Much of the fine coal in the mines is not removed and remains as a menace to life if involved in dust explosions. Much of the fine coal removed from the mines accumulates in the great black piles of *culm*, where it may or may not burn from spontaneous fires; or it may be shipped away and marketed as slack; or in a few cases this fine coal is being briquetted and sold at prices as high as those obtained for the best lump coal.

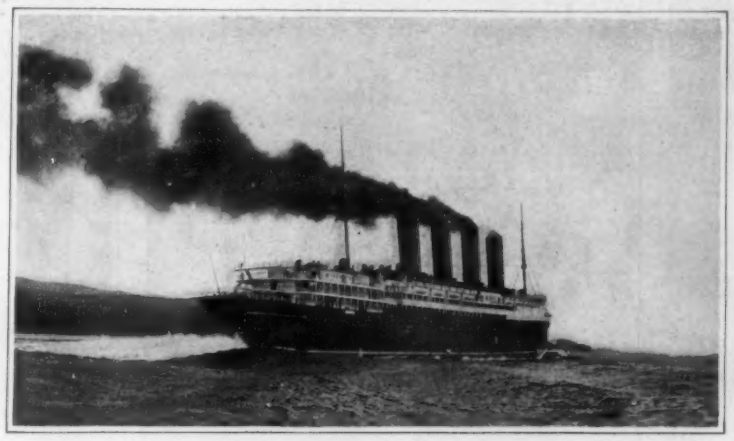
All the above sources of waste relate to the losses in mining a single bed of coal. Still other losses come where several beds of coal occur one above the other with thin intervening beds of rock, from the prior mining of the lower bed. This often results in an irregular breaking and settling of the overlying bed or beds of coal in such a manner as to seriously interfere with the subsequent mining and recovery of this overlying or upper coal.

In other countries regulations require in such cases the prior mining of the overlying or upper beds of coal, in order to avoid this unnecessary settling and breakage of successive higher beds. But in the United States each company has followed the law of "present profits" and least resistance; and the "future welfare of the nation" has remained an irridescent dream.

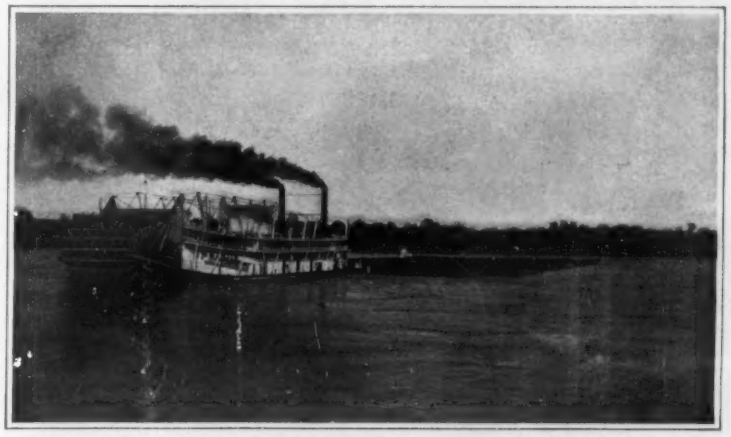
Losses in the Transportation of Coal.

From the shaft and the tipple the coal falls into the forty or fifty-ton coal cars for transportation by rail (see photo), or into the barges for transportation by river (see photo). In these transport barges, as seen on the Ohio and Mississippi rivers, a single small stern-wheel steamer attached at the rear of the group of the barges, may carry to New Orleans from 40,000 to 60,000 tons of coal (photo).

If intended for ocean or lake transportation by steamer, the coal may be allowed to run from the opening in the bottom of the car (or an elevated track) directly into the hold of the steamer; or each car may be elevated separately and inverted, the coal rushing down the chute into the steamer's hold. At the other terminal port the coal whether transported by barge or steamer is lifted by great steel grab buckets and placed on storage platforms (see photo), or again placed on cars for further transport (see photo). At every handling of the coal there is an increase of fine coal or slack (photo), and a small per cent of loss. But often the total actual waste in the haulage, including the several transfers, will aggregate less than 10 to 15 per cent of the original tonnage; and while the fine or slack coal sells at prices from 20 to 50 per cent lower than the good lump coal, with modern automatic stokers and briquetting plants, there is really little loss in actual heating value.



This ship consumes 1050 tons of coal each day.



Steamer "Sprague" towing 56 coal boats, containing 1,400,000 bushels of coal.

Good haulage minimizing production of coal dust.

Undercutting coal with compressed air drill.

THE USE AND WASTE OF OUR COAL SUPPLY

Losses in the Use of Coal.

Great as are the losses of coal in mining, they are proportionately less than in its burning in the furnace of the country. The experienced manufacturer who, as a large consumer of coal, habitually watches the double entries on the pages of his ledger for profits and losses, does not hesitate to express his surprise and disapproval when he hears the story of mining losses, approximately 250,000,000 tons of coal in a single year; but in doing this he often loses sight of the no less serious fact—that of the coal used in his own furnaces, *less than 10 per cent of its heat units are converted into mechanical work* in his factories; or the larger fact, that of the 300,000,000 tons of coal probably used in the power plants of the country (including locomotives), 270,000,000,* or 90 per cent of the whole, was lost in the several transformations of energy; and not more than 10 per cent of the heat units, or the equivalent of only 30,000,000 tons of this coal, was transformed into the mechanical work of the nation.

The situation seems clearer if these losses are subdivided or classified. This cannot be done accurately in a general statement, because of the variations in the different furnaces, boilers and engines. But taking a common type of smaller power plant, the disposition or consumption of British thermal units in the burning of the ordinary bituminous coal (containing 13,500 B. T. U.) has been given as follows:

	B. T. U.	Per cent.
Loss in ashes	135	1.00
Carried off in gases....	2,970	22.00
Loss in radiation from boilers	675	5.00
Carried off in auxiliary exhaust	190	1.41
Loss in radiation and leakage, main pipes..	210	1.56
Loss in radiation from small pipes	30	0.22
Loss in radiation from engine	280	2.07
Rejected to condenser..	7,737	57.31
Converted to power or mechanical work.....	1,275	9.43
	13,500	100.00

The government of the United States is probably the world's largest owner of coal lands; it also operates a large number and variety of heating and power plants located in widely separated parts of the country, besides the Panama railroad, lines of transport steamers, and its naval vessels. Furthermore, the fuel problem enters so largely into the manufacturing, transportation and interstate commerce of the whole country that they may be reasonably classed as national problems.

In recognition of these facts, Congress several years ago authorized an investigation of fuel problems, first under the Geological Survey, and subsequently under the Bureau of Mines. Under the latter bureau this work is now being reorganized, and co-operating with other existing agencies, the engineers and chemists of the Bureau of Mines, working at its Pittsburg laboratories, are endeavoring to locate and reduce or eliminate as far as may be possible the sources of loss or waste not only in the mining, but also in the use of our fuel resources.

(*Continued on page 150.*)

* This does not include a loss which in extreme cases may reach 25 per cent of the coal, where finely divided non-coking coal passes through the grate bars in an unburned condition, along with the ashes.

A truck with a stone-dumping body.

The Versatile Motor Truck

Novel Designs and what They Accomplish in the Economical Handling of Material

By Harry W. Perry

A truck used as a hoist.

BECAUSE the motor truck is a work machine, it is relatively ponderous and slow; but what it lacks in speed and grace of design is more than made up in the spectacular nature of its varied activities. It does not make such a direct personal appeal as the pleasure car, since not many look upon the business vehicle now as a machine from which any personal pleasure or direct benefit can be derived. When, however, the mind dissociates from the mention of commercial motor vehicles the thought of mere substitutes for horse-drawn trucks and delivery wagons, it will become evident that the term embraces a great variety of types—all, in fact, that are not classed as private pleasure cars. While motor trucks are business vehicles, they are not necessarily prosaic.

In due time more interest will be shown in so-called commercial motor vehicles than in private pleasure cars. The masses in the cities will come to realize that they have as direct a concern in motor omnibuses, taxicabs, sightseeing cars and the varied types of municipal vehicles and cars for Federal purposes as they have in runabouts, touring cars and limousines. In the self-propelled fire apparatus with which all progressive cities will be supplied in a few years, the people will see the instruments of thrilling rescues of human lives and property. In motor patrol wagons they will see the means for prompt quelling of riots and removal of dangerous and disorderly persons; in motor ambulances the vehicle for relieving human, equine and canine suffering; in the motor mail wagon the mechanism for hastening communication.

When we consider the conditions that will prevail when these types of power vehicles and the great variety of other forms for industrial and mercantile purposes have been generally adopted, and when we shall have an opportunity of comparing the clean, smoothly-paved streets, the freedom from flies and germ-carrying dust, absence of the noise of pounding horse hoofs and steel tires, reduction of traffic congestion and the elimination of the harrowing sight of horses prostrated by midsummer heat or crippled by winter's icy pavements, with conditions that prevail now, every thinking person will be impressed with the idea that the pleasure car with which the civilized world has been obsessed for more than half a decade is, after all, a relatively small factor in a revolutionary change in a method of transportation almost as ancient as the human race, and that this change touches the life and has a direct bearing upon the well-being of every individual in the city.

Aside from the striking nature of public services in which motor vehicles are engaged, there are many applications of the machines to private enterprise that are most interesting. All sorts of work, from thawing frozen water pipes in an emergency, to drawing plows in the farm fields, come within their scope of utility. At least 125 distinct lines of trade are using the trucks built by a single big manufacturing company that produces only machines of three tons capacity. It is natural, of course, that the motor truck should have been adopted more generally by the lines of business that found the horse least capable of doing the work required, either because of its difficult nature or because of long distances to be covered in a short time and long hours of service that would seriously fatigue the best animals.

Just to cite one kind of work that is beyond the capability of horses to do successfully, it will be remembered perhaps that early last spring several sixty-ton steel girders for the new Municipal Building in New York were hauled from the river front, near the Battery, to the location of the building at the Manhattan end of Brooklyn Bridge. Thirty-six horses, hitched in an almost unmanageable string of eighteen teams, were used for draft purposes, and because of the interruption of traffic and confusion that would have been caused in the metropolitan streets of such an outfit during business hours, the girders were hauled during the night and on Sunday. In their passage numerous iron manhole covers were crushed in and considerable damage was done to the street paving. It is not difficult to imagine the vociferous bedlam that accompanied the movement of the teams and the noise made by one hundred and forty-four iron-shod hoofs, and the almost insurmountable difficulty of making the long string of horses pull in unison, and of turning corners successfully. A five-ton electric truck used for the same purpose in another city moved with ease a trailer weighing five tons and loaded with a steel girder which alone weighed twenty-six tons.

One of the most exacting branches of transportation work is that of the big express companies, which receive and send their shipments by fast passenger train and must perforce conform to railroad schedules. All of these companies use some motor wagons, and one in particular, which has used steam, gasoline and electric power wagons continuously for the last eighteen or twenty years, now does the major part of its transfer and delivery work with electric wagons in the principal Eastern cities. The gasoline trucks owned by another of the national express companies are operated on a time schedule as exact as the railroad time sheet, and are kept in service twenty hours out of twenty-four, with a double shift of drivers.

A tilting body operated by means of a hand winch and rollers. This operation does not require any greater physical exertion than the cranking of an ordinary gasoline motor.

A motor truck carrying not only its own load but hauling an ordinary truck as well.

A truck unloading boards. The driver sits in a cab which completely protects him from wind and weather.

Delivery work for department and dry goods stores calls for the covering of routes too long to be successfully served by horses. One New York store has a route of more than sixty miles that is covered daily by one motor wagon and one driver, with an average of about one hundred stops for delivery of parcels. Horses, of course, could not be used in this case, for even if two changes of teams were made in the day, the speed could not be maintained. Some big department stores make their long hauls into outlying residential sections at night, and make their local deliveries the next day from distributing depots. In this way one big house keeps its heavy trucks running twenty-two hours a day except on Sundays, when they are given a thorough inspection, cleaning and adjusting. A trip on one of these department store or express trucks in the middle of the night would prove quite as novel and interesting as a night run of the same duration in a touring car under ordinary circumstances.

Coal, beer, lumber and machinery trades and many lines of heavy manufacturing whose hauling is hard on horseflesh have adopted the motor truck freely and are getting excellent service from the machine. Peculiar conditions that obtain in some of these businesses have resulted in the development of special quick loading and unloading methods whereby the vehicle can be kept on the move during the maximum number of hours daily, thereby realizing the principal advantage that it possesses in superior speed and endurance over horses. Coal dealers order their power trucks fitted with bodies which are provided with chutes, and which can be raised above the frame of the chassis at a sharp angle so that they will empty their loads of from three to ten tons by gravity in from five to fifteen minutes, with little or no shoveling. Contractors are becoming frequent purchasers of motor trucks fitted with dumping bodies that can be discharged of their loads sometimes in less than a minute. Most of the dump trucks so far built are tipped by the manual turning of a crank, but several have been built to order that are equipped with power-operated tipping mechanism. One of these is a seven-ton gasoline truck that is often used for hauling hot asphalt. This material has a tendency to stick, and consequently the body had to be constructed to tip to an angle of forty-five degrees. It takes only forty seconds to elevate this body with power from the engine and discharge the seven-ton load.

Ingenious quick loading and unloading methods have been developed by the lumber trade whereby a motor truck can take on a load of three to seven tons of lumber as a unit in a few minutes, the turning of windlasses by hand serving to roll or slide the load from a horse truck upon the power vehicle, which then leaves the yards to deliver it. The horse trucks are driven to the different lumber piles to be hand loaded, and thence to the wagon shed to await the motor truck, a single team of horses sufficing for about a score of such wagons. The loads can be discharged from the power trucks by releasing ropes or chains at the rear end and allowing the lumber to roll back by gravity or by rolling the load back by turning the cranks on the rear end rollers until the ends of the boards drop to the ground. Then the truck is driven out from under the forward end of the load.

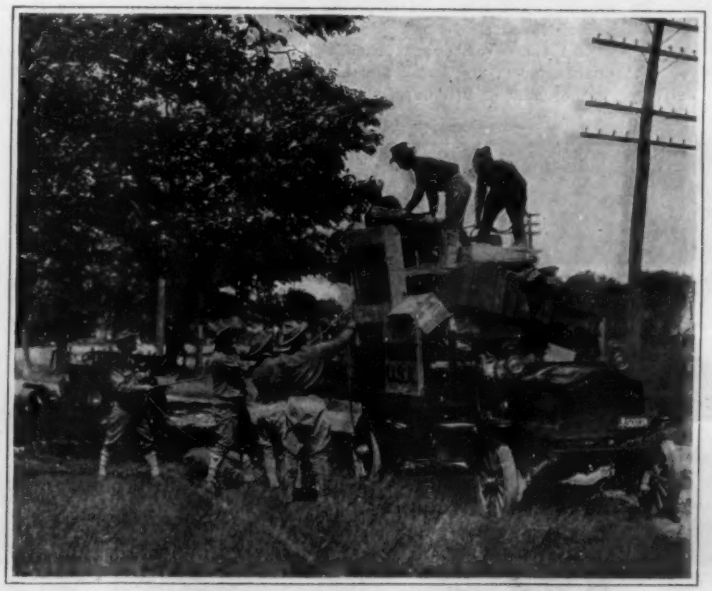
A leading department store in New York and another in Pittsburg operate eight or more three-ton trucks each that are especially arranged for quick loading and unloading. Light bodies of crate construction are built to fit inside the regular covered bodies. When a truck arrives at the store this inner body is withdrawn upon a hand truck to the rear, and on this is taken to any floor in the store by means of a freight elevator to be loaded. A duplicate crate that is waiting ready loaded is put in its place and the truck starts off with it. The reverse process occurs at the other end of the truck's route. In a record load for one of these trucks at Christmas time were 3,000 parcels. Ordinarily the proper loading of the packages requires from one to three hours, so that the system enables the truck to make two or three times as much mileage as would be possible if it had to stand idle while undergoing the ordinary loading and unloading processes. The average daily mileage of seven of these trucks used during a fifteen-month period in New York was seventy-two miles each, counting twenty-six working days to the month. Several of the machines averaged one hundred and ten miles a day for months at a time.

An ambulance in action.

A motor truck carrying Ovington's 70-horse-power Bleriot machine to an aviation meeting.

Wrecked aeroplane carried from the aviation field by a motor truck. In this aeroplane St. Croix Johnstone nearly lost his life at Detroit. The truck arrived at the scene of disaster almost as soon as the ambulance.

A 14-ton truck hauling and trailing coal.



A 3-ton truck moving camp equipage in maneuvers of the 26th infantry, U. S. A., south of Detroit, June 1st, 1911.

The combination of vehicle and power plant that constitutes the motor truck renders the machine available for many classes of work heretofore done by hand and by portable or stationary engines. In fact, it is a self-moving portable power plant. In its most common form as such it is fitted with a winch or windlass, usually under or just back of the seat, which is turned by power from the vehicle. The winch may be gear driven from the engine of a gasoline machine, or turned by a small independent electric motor supplied with current from the battery of an electric truck. In either case the winch can be used for a variety of purposes. Both types of trucks are used by a large safe manufacturing company which utilizes the power winches for loading the safes on the platform of the truck by drawing them up a pair of skids and also for hoisting the safes to and lowering them from windows of any floor in tall office buildings. This method has the advantages of being quick, safe and cheaper than the old way of having a gang of workmen turn a hand windlass. Fewer men are needed, passersby on the walk and traffic in the street are inconvenienced for a shorter time, and customers of the company are better satisfied by the briefer interruption of their office work.

A few years ago all telephone, telegraph and electric light and power wires that were placed in underground conduits were drawn into place by gangs of laborers who turned huge wooden capstans that had to be set up in the street, anchored in position by iron pegs driven in the pavement and moved from block to block on wooden rollers which were taken from behind and put in front as the capstan moved along for the next successive step in the work. Compare this primitive procedure with the present-day way, in which cables of wires are drawn into place under the street by power winches on heavy five-ton motor trucks. In New York one electric light and power company uses half a dozen such trucks for this purpose, and also for the more spectacular work of erecting the heavy ornamental cast-iron electric light poles used for city lighting. These poles are thirty feet long, and are much too heavy to be set up by laborers without a derrick. But the truck, with its power winch, makes easy work of the task.

By way of an aside, it is pertinent to observe right here as an indication of the trend toward the horseless condition that is predicted for large cities in the near future, that the New York Edison Company has abandoned altogether the use of horses in Manhattan and a large part of the Bronx, and employs instead a "fleet" of eighty electric trucks and delivery wagons. Within the next five years, and probably sooner, it will get rid of all its remaining animals, as will also the New York City Fire Department, some of the express companies and many retail houses in the metropolis, some of which are now operating from forty to nearly one hundred motor delivery wagons.

In addition to the ways already mentioned, the power plants of motor trucks are used in an auxiliary way for pumping water out of manholes in the streets of cities.

Typical group of California oil wells. Note lake of oil in foreground.

Conservation of Oil and Natural Gas

Economies in Field, Factory and Home

By Dr. David T. Day, United States Geological Survey

IN regard to conservation of our natural mineral resources, the petroleum industry affords a better example of what can be accomplished in useful application and preventing of waste, rather than an illustration of deplorable waste which has been the theme of most that has been written on this subject for other industries.

Nevertheless, the petroleum industry is one of the most vital cases for exercising every possible care in the utilization of a limited amount of material. The gloomy outlook for the United States, without great care in utilizing the stores of petroleum and other fuels, is well illustrated by the present condition of Italy. For, in spite of a climate unexcelled for the growth of plants, and with men and women strong and skillful in the arts of agriculture, the peasants are proverbially poor. Only a few days ago in looking at an Italian photograph of an unusually strong woman, carrying on her head a large bundle of firewood, I was puzzled to explain how poverty was consistent with this magnificent physical development, and yet the picture carried in it the obvious reason. The world has moved past the stage when human power is sufficient in daily labor. Aid must be had from power from a large supply of cheap fuel, in addition to the energy to be contributed by human labor, and only the countries prosper where such fuel is abundant. Italy's fuel supply has burned out, unless they harness the exhalation from Mt. Vesuvius. Even the wood which the woman in the picture was carrying is scarce and costly, and in no way sufficient for the development of enough energy for efficient manufacture.

Contrast this condition with the United States. We have a supply of at least 10 billion barrels of petroleum, in what we already know of the resources of the United States. From these vast resources we produced last year over 200,000,000 barrels of oil. In addition, we produced natural gas to a value of at least $65,000,000. In other words, leaving out of consideration copper and iron, the oil and gas of the United States was worth more than the gold, silver, lead, and every other metal product produced in the same length of time. It is important to emphasize the fact that we do not need this great production. But there is no possible method of preventing the producers of oil from taking it from the earth as rapidly as possible where they either own the oil lands or own leases on the oil lands, and there is no way of curbing the haste with which the oil is pumped out by one producer lest his neighbor will secure the greater part by prompter action. The ability of the owner of any large tract of oil land, such as "the people," as owners of the oil on the public domain, or of any large oil company with a large tract of developed oil land, to withhold development on these large tracts is admitted, but aside from this, the known oil fields will be developed as rapidly as human enterprise can put the product above ground.

Intelligent utilization of oil, therefore, has had to face extreme conditions of sudden floods of oil and in general more oil than was needed. These exceptionally trying conditions have been met with significant success. It is very much easier to record the failures to conserve, rather than the nearly uniform success. When the Lucas gusher broke loose near Beaumont, Texas, the oil was lost for lack of tankage for a few days and fire added to the waste. In the opening days of the Glenn pool, in Oklahoma, oil ran to waste down the creek, and in California the first flows of the Silver Tip, the Lakeview and other gushers have been lost, but the total loss from all these sources is trifling.

This is an achievement which calls for great congratulation rather than the criticism of methods which has been found necessary in considering the conservation of coal and the shameful devastation of our forests. Perhaps it will be useful to discuss how this careful saving of petroleum has been brought about, as a means of inspiring similar enterprise in other industries.

Oil conservation goes back beyond all the oil companies great and small and begins with Samuel Kier, a merchant of Pittsburg, who was also, from necessity, an inventor, or better still, an adapter, of a lamp for burning oil. He added a chimney which made the oil burn with a bright light. This supplied a market which did not before exist and which has spread from Pittsburg to remotest China. A. C. Ferris came next with his genius for oil traffic. He began the process of exporting oil from Pittsburg to the ends of the earth. From that day to this, business sagacity has dominated oil.

Pipe Lines.—It was the spur of business competition that developed the *pipe line*, at first facing hostility and actual violence from the army of teamsters, in order to get the oil from the well mouth to a railroad or river landing; and finally, invoking engineering skill, the oil men emancipated themselves from railroads and pumped oil over the Alleghenies to tide water. Pipe-line efficiency has been perfected in both directions—toward the consumer and toward the producer. The refineries have tended to accumulate near the coast because it was evidently cheaper to transport the oil in the crude condition as far toward the consumer as possible, and only to resort to costlier transportation methods when it became necessary to convert the oil into the products to be consumed, each of which must be distributed by its own system.

The pipe lines have increased in number, and economy has been promoted by the best types of pumping equipment. In fact pumping engines have been greatly developed for all purposes by the demand for them afforded in transporting oil.

Meantime the branch, or "gathering," lines have crept outward as the oil pools increased until there are now many miles of pipe lines in the United States. Of greatest help, however, has been the system by which the pipe line has always been extended to the well mouth *promptly* when new fields have been discovered. The only burden for the oil producer has been the development of his oil pool. It has become axiomatic, that the oil is as good as sold as soon as it is produced.

Uses of Crude Oil.—It is evident that the requirements of the moment must be considered in the uses

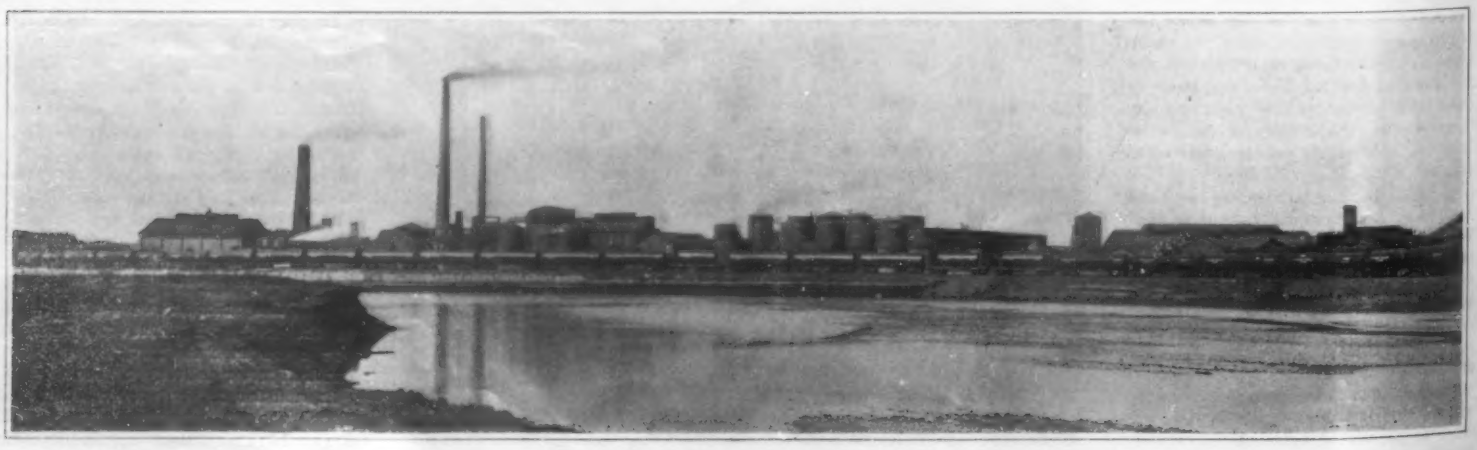


Photo. by Bliss Bros., 1910.

Train of petroleum tank cars at Buffalo.

for oil, and not the ideal utilization based upon the highest grade products that the oil can be made to yield. In fact the sudden floods of crude oil have made it necessary to get rid of the oil for any purpose whatever, so long as the oil is consumed. Of the entire supply, the greater part has been distilled and refined so as to yield the greatest amount of lamp oil of satisfactory quality and the minimum of by-products such as gasoline, paraffine wax, lubricating oil, and coke products. Usually there has been a steady market for lamp oils at home and abroad. Within the past few years this policy has of course greatly changed, due to the increased demand for gasoline, and due also to the over supply of kerosene. The consumption of kerosene has not declined. It has increased, but not so rapidly as the production of crude oil.

Fuel Oils.—This necessity of forcing a market for crude oil has developed uses which might long have lain dormant. Chief among these is fuel oil, second, and always increasing, is road oil. Luckily the recent great finds in Texas and California have been very suitable for use as fuel for power purposes. Under extreme conditions, all kinds of crudes have been used for fuel; but they are better suited for the purpose when the gasoline and burning oil have been removed. Fortunately it pays to take out these portions, and therefore the so-called "skimming" plants have been successful. As a rule wherever these fuel oils have been used an advantage has been demonstrated. This includes all kinds of power plants, locomotives, and finally the marine engine. The advantage on locomotives is evident; for the size of a locomotive is limited by the amount of coal that a fireman can feed in a given time. Thus in the Northern Rocky Mountains the limit of size has been reached by this human limitation, at least until an oil supply can replace the coal. Then the size and efficiency may increase again.

Internal Combustion Engines. — For marine power, oil's efficiency includes, besides increased capacity, elimination of the smoke nuisance on passenger craft, with its attendant cost of paint, and of the smoke danger for war vessels.

Oil in the Navy.—The effect of this is that more than 25,000,000 barrels of oil per year must be set aside for naval purposes in the United States, and the merchant marine will require as much more. Further it must be remembered that the great majority of the known petroleum resources of the world are here in the United States. One effect of this was seen in the days of the flood of oil at Beaumont, Texas, with oil selling as low as 10 cents per barrel, where it was recklessly applied to any purpose. Every effort was made by those interested in the welfare of oil to induce the changing of the use of petroleum into other more conservative uses, such as distilling out as much gasoline and kerosene as the oil will yield, and converting as much as possible of the residuum into various lubricating oils and thus avoiding the use of oil as a low grade fuel in competition with coal. Now, however, for the reasons given, the use of oil in internal combustion engines has become one of its most beneficial uses.

In the future, therefore, we can expect the very best utilization of our valuable oil supplies to proceed along the lines of burning it for the production of power. This method of burning oil constitutes an example of modern conservation of resources.

Oil for Good Roads.—Another use that can really be considered as consistent with the conservation of our mineral supplies is the use of petroleum residues for making good roads. Road oil, as manufactured from Texas and mid-continent oil residues, probably promotes as great economy in national life as any other use to which it can be put.

Lubricating Oils.—Meantime we must not lose sight of the fact that modern progress would cease, the movement of all machinery would stop, were it not for mineral lubricating oils. The former supplies of animal and vegetable oils suitable for lubrication are trivial compared with the demands of modern machinery. Mineral lubricating oils are as essential to machinery as the telephone is to the conduct of business affairs.

Protection of Future Supply.—As already pointed out, we are producing more petroleum than we need, and we are obliged to export the surplus. This surplus goes to the ends of the earth, and from the broad standpoint of the world's economy it is necessary for progress. From the more limited standpoint of the economy of the United States, it would be better to keep it at home until needed.

The necessity for thus husbanding our petroleum resources is so evident that it will be accomplished, partly by the purchase of large tracts of petroleum lands by large corporations who will hold these supplies for the future, and partly by the withdrawal by the National Government of such oil lands as remain on the national domain in the interest of future use. A most favorable sign of the times is the agreement between companies in California that each shall keep back a certain number of hundred feet from the dividing line in order that neither party will draw the oil from the other's territory—an arrangement which makes it no longer an inducement to withdraw the oil from one tract to prevent its being exhausted by the wells of a rival tract. The extension of this policy is consistent with common sense and business interests. Two recent very successful feats in oil engineering have greatly improved the prospects of a long continued natural gas supply in the United States. A great source of loss in this country has been the waste of at least 100,000,000 cubic feet of natural gas per day in the Caddo field in northwestern Louisiana. Repeated claims have been made that these oil and gas wells could not possibly be controlled. Within the last two months the engineer of the Caddo Gas and Oil Company, of Shreveport, Louisiana, has completely controlled one of these great volcanoes of gas, water and oil, and the feat was so easily accomplished as to make it altogether probable that the other wells will be quickly controlled in the same way.

At the time this article is being written, another great problem is being solved in this same Caddo field. An oil well gushing at least 20,000 barrels per day, together with a large quantity of natural gas, has been on fire for several weeks, defying all attempts at extinguishing the fire or controlling the flow. As a last resort a tunnel has just been finished. The intention is to cut the pipe and divert the stream of oil through the tunnel and thus extinguish the fire and control the well.

With the steps thus in progress for the conservation of oil resources, it is probable that the oil supply of the United States is in a fair way to be protected for many generations to come, and it is certain that the methods of using this material are more satisfactory than for most other minerals.

Typical oil gusher.

Toure petroleum peddler. Roumania.

Petroleum peddler. Roumania.

OIL IN EUROPE

Injury to Lumber by Fungi

BLUE and black stains on lumber stored in yards decrease the value of the lumber, without, however, injuring the wood, since it has been found that the fungi which cause the stains feed upon the materials within the cells of the sap-wood, and do not destroy the fibers. These fungi are largely of the black-knot family, and the most common are species of *Graphium* and *Ceratostomella*. It has been the custom of the lumber companies to dip the wood in solutions of sodium carbonate or bicarbonate immediately after the sawing; but the results have been very uneven. To find out why the alkaline solutions sometimes prevented the development of the fungi, and at other times had no effect whatever, Miss Caroline Rumbold started a series of experimental cultures at the Missouri Botanical Garden in St. Louis.

Nutrient media were prepared containing from one-half to two per cent sodium carbonate, and others with similar amounts of citric acid. The spores of *Ceratostomella* germinated and the fungus thrived on the acid media, and on those containing 0.5 per cent of Na_2CO_3, but not on those with 1 per cent or more of the alkali. Freshly cut sap boards of yellow pine and red gum were then dipped in hot and in cold solutions of sodium carbonate and of sodium bicarbonate, of various strengths, from 1 per cent to 10 per cent. These boards were inoculated with the spores of the fungus and kept in chambers with a saturated atmosphere. Controls were simply dipped in water, and some of the red gum boards also in sulphuric acid (5 per cent and 10 per cent). The fungus developed on all the controls, including the sulphuric acid boards, and on most of the boards dipped in the alkaline solutions. The hot dip was found to be more effective in inhibiting the growth than the cold solution, and the carbonate of 7 to 8 per cent as effective as bicarbonate solution of 8 to 10 per cent.

Increase of Crop Yield in Germany

ON the twenty-fifth anniversary of the German Agricultural Society there was published a table showing the progress in the yield of various farm crops during the quarter century. Some of the items are given below, the figures representing pounds per acre:*

	1885	1910
Rye	1,050	1,486
Wheat	1,344	1,771
Barley	1,335	1,735
Potatoes	8,989	12,370
Oats	1,255	1,710
Hay	2,910	3,863

It is pointed out that this progress is not due merely to better treatment of the soil, or to more abundant fertilization, or a more intelligent selection of seed, etc., as is commonly supposed, but also in a measure to a differentiation of crops in accordance with the adaptability of each particular type of soil.

*Original report, quintals per hektare.

Reclamation and Home-making

I.—Review of General Conditions in the Reclamation Service

By F. H. Newell, C. E., Director

ONE of the most far reaching but little known works of the United States is that of the reclamation by irrigation of arid lands. These lands form about a third of the total area of the United States and although only a small proportion can be irrigated, yet the farms and homes which may be created have such great value as to become a notable addition to the wealth of the nation.

It is not, however, the object merely to reclaim these lands and to add them to the productive capacity of the nation. Far beyond this is the higher object to be attained, that of rendering these areas capable of furnishing homes for thousands of citizens. The lands are not irrigated that they may add to the wealth of a few, but when reclaimed they are subdivided in tracts each sufficient for the support of a family, and are disposed of to persons who will live upon the land for five years, cultivate it and become self-supporting citizens and taxpayers.

The public lands thus reclaimed are not sold but are given away to actual homesteaders. The cost of the reclamation, however, must be returned in ten annual instalments. Thus, for example, if it has cost $30 an acre to bring the water to a given tract, and it is found that 40 acres is adequate for the support of a family, an individual is allowed to file upon this 40-acre tract; title is obtained after five years' residence and cultivation and payment to the government of the cost of reclamation, which in this case is $1,200, in annual payments of $120 each. He obtains an opportunity of acquiring a home and a piece of land which rapidly increases in value, because of the fact that as other people flock in and take up the adjacent lands, a relatively dense population is established, towns grow up, and there is an increment of value beyond the result of his own efforts—for these lands ultimately are worth $100 or more per acre.

There has already been invested about $60,000,000 in this work, and this investment is being increased at the rate of approximately $1,000,000 a month. This money is not being paid directly by the tax-payers, as it is not derived from domestic or foreign imports, but from the disposal of public lands. The moneys thus obtained are credited to a fund in the treasury, placed at the disposal of the Secretary of the Interior, and expended through what is known as the Reclamation Service, an organization composed of engineers with necessary technical and clerical assistants.

The law authorizing this work, known as the Newlands Act, from Senator Francis G. Newlands of Nevada, was passed on June 17th, 1902. It is very general in character, calling for certain results and laying down a few broad lines to be followed. All of the intricate detail had to be worked out. It was as though a great business enterprise had been authorized without indicating dimensions, character of structure, or any facts, excepting that certain funds of unknown amounts were to be expended to accomplish results in localities widely separated. The location of the works, for the most part in regions remote and without adequate transportation facilities, the magnitude and complex character of the engineering features and the difficulties encountered in adjusting the diverse interests of private owners, furnished innumerable problems, the solution of which required a vast amount of investigation and study. The first thing after the passage of the act was to get the engineers. The natural thing to do was to continue in the work the men who had been studying the subject for many years, and then to select a few localities and begin the work.

Shoshone dam, 328 feet high. Loftiest in existence.

The desert before irrigation.

Homestead on same desert two years later.

SHOSHONE PROJECT, WYOMING

There were demands from all parts of the arid West that work should be undertaken at once, and the people were inclined to chafe at any delay in the beginning of actual construction. It was difficult to make them understand the need of preliminary study and investigation, they wanted to see the dirt flying and the big dams rising in the canyons.

It was known as the result of previous investigations that several projects undoubtedly were feasible, and that certain large structures must be built in connection therewith. Work was, therefore, begun on some of these before all the plans could be elaborated. Those matters upon which there could be little question were at once entered upon, the connected details and plans for additional structures being worked out while building progressed.

The result is that a large amount of work has been accomplished in a short time and a reputation established for prompt execution, as against the idea that "government officials could not move expeditiously."

At the same time, every effort has been made to preserve accurate records of the cost of the work and to study all of the economies which were practicable under existing laws and regulations. Cash discounts were sought, as well as wholesale rates. Transportation of material was secured at the lowest obtainable terms, and the operations put upon a business basis. What this means can never be appreciated by a man who has not worked for the government, and who has not run against the innumerable complications growing out of a century of corrective legislation and executive requirements. Transacting government business on business principles is like trying to drive directly across a settled valley, which is fenced in every direction by barbed wire. The old inhabitant knows the highways and byways, the gates and the openings, and can go across the country with considerable speed, but the newcomer, who does not know these, is constantly getting entangled in wire fences and in controversy with the people and is forced to back out and finally go by the most roundabout road.

The Reclamation Service has been particularly fortunate in its ability to traverse rapidly and effectively the entanglements of legal obstacles, discovering the openings and short cuts which expedite work.

Acting under a very general law in which results only are called for, it has been possible to avoid many of the embarrassments of the more elaborate enactments of Congress, where the attempt has been made to describe in advance all sorts of remedies for every kind of emergency. Nevertheless, there are enough general laws and regulations to necessitate the greatest skill and care in making expenditures without getting one's self into continual trouble.

One of the methods adopted by the Reclamation Service for avoiding delay has been to have the disbursing of funds placed in the hands of a considerable number of bonded agents. These men are of the bank-clerk type and draw moderate salaries. The force of

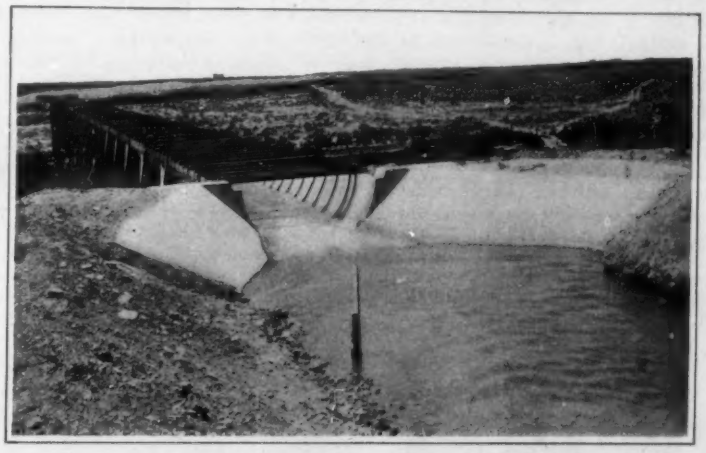
disbursing officers is large enough so that if the accounts of one are suspended on technicalities, another man can take charge, while the first devotes his time to satisfying requirements of the Treasury officials, thus avoiding delays.

The business methods have been the subject of continued study and examination by experts and have been so perfected as to serve as a model for various contracting, or other corporations, which have practically adopted the general scheme of cost-keeping, modifying the details to suit private conditions.

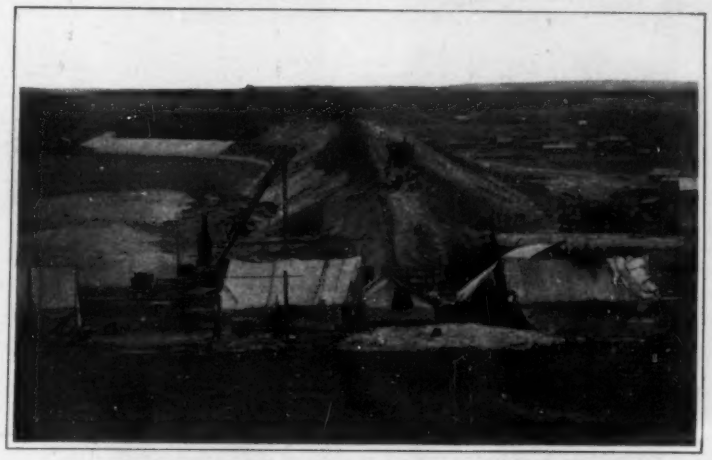
It is recognized, of course, that the government bureau cannot work as economically in some ways as a private corporation, because it is loaded with requirements of advertising for competition in all purchases, of elaborate preparation of all papers having to do with disbursements, with the attaching of numerous signatures, growing out of various laws, with almost innumerable restrictions imposed from time to time to meet special conditions and also others which were never anticipated when the regulations were drawn. Nevertheless, experience has shown that it is possible to prosecute business with reasonable economy and speed. As proof of this it may be stated that already nearly a million acres of lands have been furnished with water, and about 14,000 families are on these lands. These beneficiaries of the law are beginning to pay back into the Treasury their *pro rata* share of the cost of the work.

The results attained are an example of what may be accomplished in the practical carrying out of the conservation ideas, so ably presented by Theodore Roosevelt and Gifford Pinchot. In fact, the reclamation work may be considered as part of the great programme of national conservation, being joined with the protection and use of the forests, the saving of the water powers, and other natural resources and monopolies for the people. The outcome shows that it is possible for the National Government, through skill and competent officers, to grasp these great opportunities and to develop for the common good the resources, which, up to the present time, have been turned over to the great corporations, on the ground that it is impossible for the people to help themselves through a popular form of government.

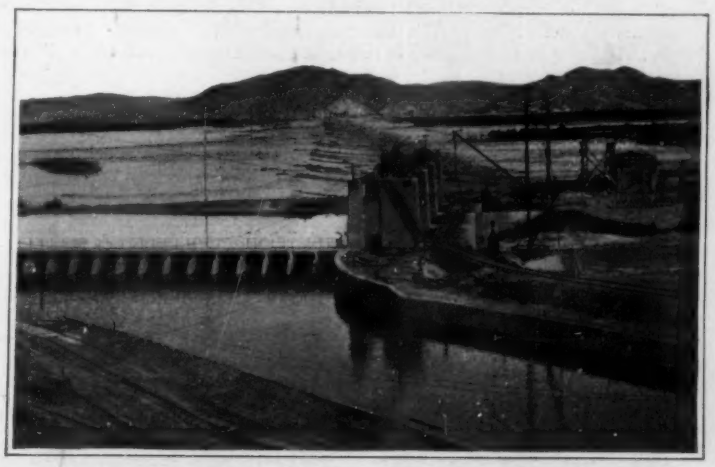
In carrying out the objects of the Reclamation Act, and embodying the ideas therein contained in feasible structures, there have already been built reservoirs for conserving the waste waters and having a capacity such as would cover four and one-half million acres with water one foot in depth. To distribute this water to the land, or take it from various streams, there have been constructed nearly 350 miles of canals of large size, that is to say, carrying over 800 cubic feet per second, while in smaller canals or distributaries, there are several thousand miles. The tunnels by which the water is carried under mountain masses or through obstacles aggregate in number nearly 70, with a total length of 100,000 feet. There are literally thousands of smaller structures, such as gates, turnouts, flumes, and bridges, each of which has required more or less engineering skill and forethought. The material excavated in building the canal system has aggregated 60 million cubic yards of earth, and nearly 5,000,000 yards each of loose rock and of solid rock. In building the dams and other structures, there have been used over a million barrels of cement.



Payette-Boise project, Idaho. Flume crossing a creek.



Belle Fourche project, South Dakota. Owl Creek dam.



Yuma project, Arizona. Laguna dam from California side.

These figures will give some idea of the gross magnitude of the work; but to the men interested in scientific or engineering facts, they are less instructive than a few details concerning some of the more interesting or typical of the works now built.

The results accomplished, however, are far more important than those which can be shown in figures of quantity, size, or cost. They relate to those higher and larger objects of life which rank above mere material prosperity, in that they contribute to the development of a citizenship, of far greater importance to the nation than the possession of wealth. The object of the Reclamation Act, while directed immediately toward the construction and maintenance of irrigation works is really more far reaching; for these works are the foundation for homes for its citizens and their use is conditional upon the ownership of the reclaimed lands in small tracts sufficient for the support of a family. This means that there can be no land monopoly. Each farmer or beneficiary of this law can obtain land or water sufficient only for his own use. He must be one of a group of independent landowners living in relatively thickly settled communities, where success is attained through intensive cultivation, and where there thus results the ability to enjoy the comforts or even luxuries which are incident to a carefully cultivated, densely populated, or suburban locality. The man who has been a mechanic or has pursued some trade in the city or has wandered about the face of the earth is offered an opportunity to secure for himself a home, with reasonable expectation of competence in his old age. He must endure at first the privations of pioneering, and must have energy and use good judgment; but there is no occupation in which a more substantial reward will come for efforts intelligently expended.

From the standpoint of the commonwealth, the gain is great in transforming the indifferent citizen, who has been living in an apartment or wandering about from place to place, into a settled, taxpaying voter, interested in everything which concerns the locality, the county, the State, and the nation.

Salt River project, Arizona. Roosevelt dam, upstream.

Salt River project. Boating on lake formed by Roosevelt dam.

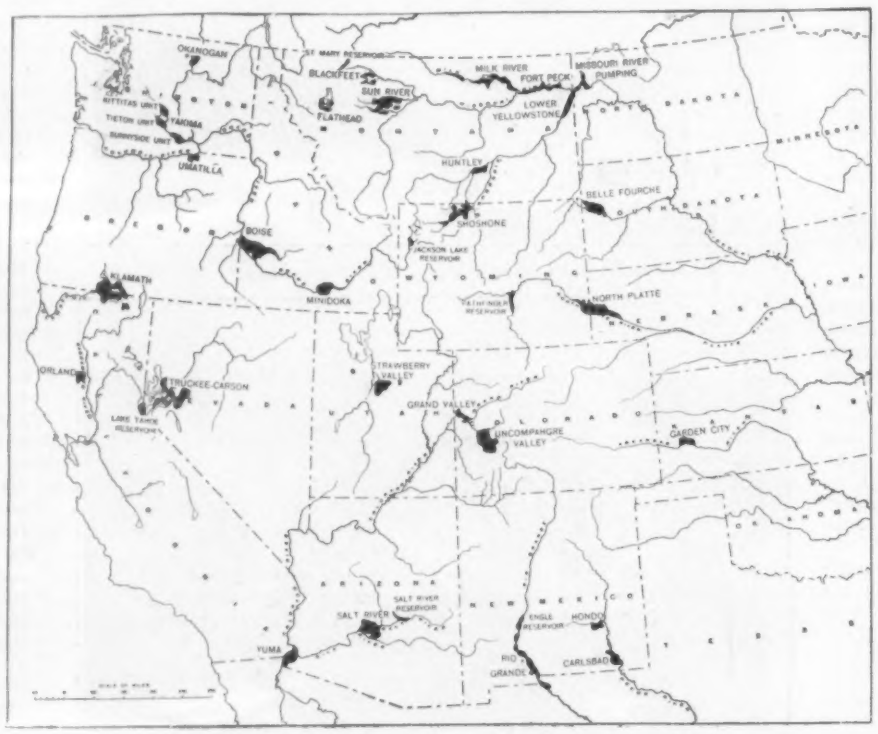
RECLAMATION AND HOME-MAKING

II.—The Engineering Work of the Reclamation Service

By A. P. Davis, C. E., Chief Engineer

IN the early days of the operation of the Reclamation Act the principal engineering problem was the examination of irrigation projects and the selection for construction of the more feasible of these, modified by the legal requirements of geographic distribution.

The local engineers of the service made preliminary surveys which were inspected from time to time by the consulting engineers, until what was deemed the most feasible project presented by local conditions was whipped into shape and submitted to a board of experienced engineers for the purpose of determining its feasibility. A report of this board was submitted to the Secretary of the Interior, and one by one projects were approved in all of the States to which the act referred, excepting Oklahoma, in which no feasible project has yet been found. Construction began in the Carson Valley, Nevada, in September, 1903, and soon after in various other States, until the approved projects were all under consideration. The construction work accomplished since the passage of the act, up to December 31st, 1910, is given in the table on page 148.



Map showing the various projects of the Reclamation Service.

The diversion of water for irrigation in the arid regions of the United States is not new, but has been in progress for over half a century. Through the efforts of individual and corporate enterprise, the smaller and easier projects have been mostly carried out—these usually involving the diversion of the natural flow of a small stream over a smooth valley adjacent. As the smaller and cheaper projects are developed and those involving heavier work are undertaken, the development becomes more and more difficult for private capital and less certain of profitable returns. At the time of the passage of the Reclamation Act these causes had greatly checked the development of irrigation enterprises by private investment, and the engineers of the service found the projects usually involved engineering construction of considerable magnitude and difficulty. More than three-fourths of the projects undertaken required the construction of an expensive storage reservoir, and the majority also required the construction of expensive diversion dams, tunnels, aqueducts or other structures relatively difficult and expensive, and often requiring a long time in completion. For example, the Roosevelt dam in southern Arizona, recently completed, contains over 350,000 cubic yards of masonry, and forms the largest artificial reservoir now in existence; the construction of this reservoir required the expenditure of nearly $300,000 in wagon roads alone, to make the region accessible and to replace public roads submerged by the artificial lake. The heavy cost for transportation also compelled the manufacture in the vicinity of the cement, lumber, brick and sand necessary in this large construction.

The storage dam on Shoshone River in Wyoming is the highest dam in the world, and the Reclamation Service is now beginning the construction of a still higher dam in Idaho.

The Gunnison Tunnel in Colorado, recently completed, is nearly six miles in length and was constructed under extreme difficulties presented by the presence of hot water and gas in great quantities, and the shattered condition of the formations pierced. The contractor for this tunnel failed and the work was carried out by the direct employment of labor under the engineers of the service; it required nearly five years in construction, and an expensive storage reservoir must yet be built to permit the complete development of the lands under the project.

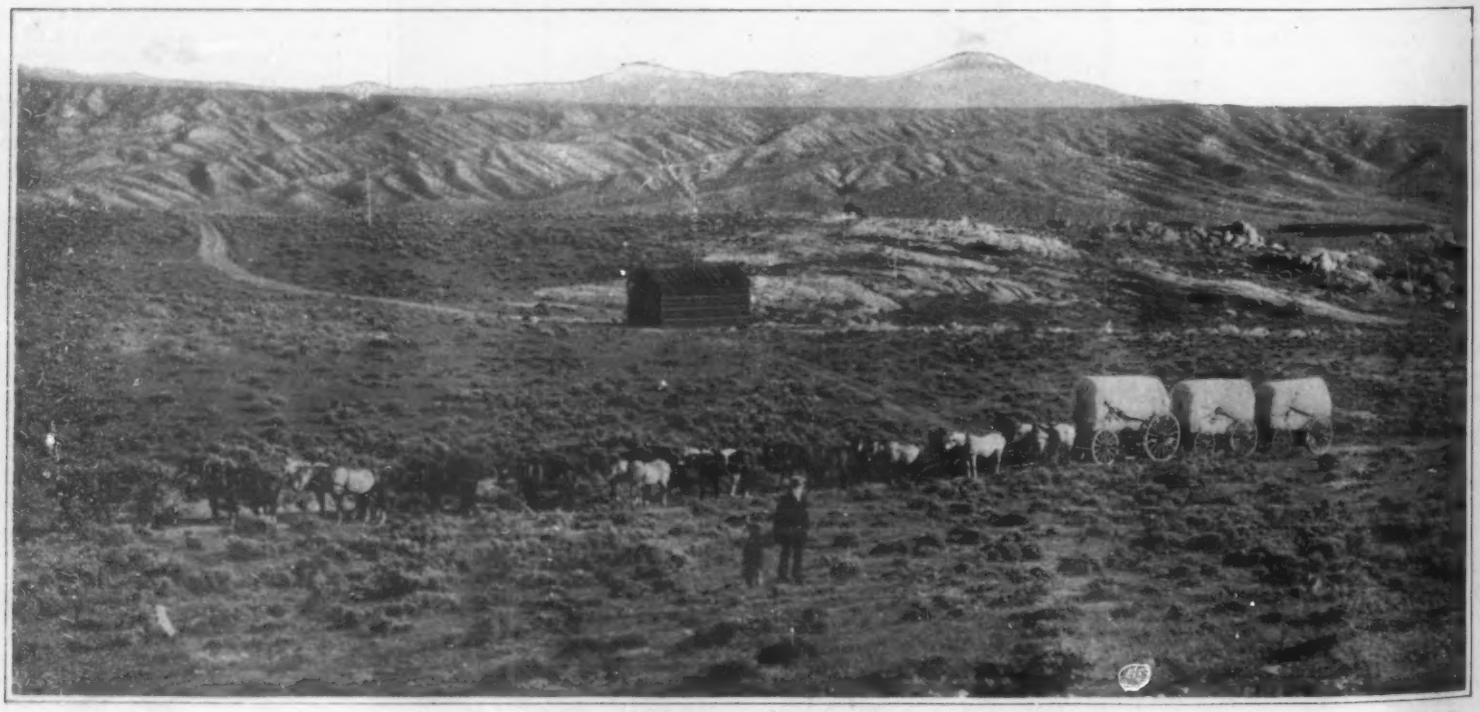
Some projects require for their proper development a very broad and comprehensive study of conditions over a large water-shed, usually extending across State lines.

A typical example of this kind is the North Platte Basin, where a storage reservoir has been completed which will store over one million acre-feet of water, and will control the entire flood of the North Platte Basin in years of ordinary flow. This reservoir will hold the water that would run to waste in the winter months, and also store the excessive-flood waves from melting snow in the months of May and June for use during the late summer and autumn, when the natural flow of the river is at its minimum.

The construction of this reservoir to about the capacity above mentioned is indispensable to the complete development of the water supply of the North Platte River; its capacity is far above the needs of the government project now constructed at a cost of about $3,000,000. The surplus storage may be used in the development of additional projects in the basin, and in completing the water supply for similar private irrigation enterprises previously instituted.

The far-seeing policy which prompts the construction of this large reservoir under these circumstances would hardly be feasible for private enterprise, which must assure itself of an early return of the invested funds; yet, such policy as that followed was absolutely essential for the proper conservation of the natural resources. The same principle holds true with the majority of the larger projects undertaken.

An interesting fact, incidental to some projects,



Pathfinder dam, Wyoming; 22-horse freighter hauling cement 45 miles to dam site.

NORTH PLATTE PROJECT, NEBRASKA-WYOMING

is the utilization of the water power made available by the irrigation works for the increase of the water supply by pumping from underground sources, and more completely utilizing the existing supply by raising a portion of it to higher levels which cannot be reached by gravity ditches.

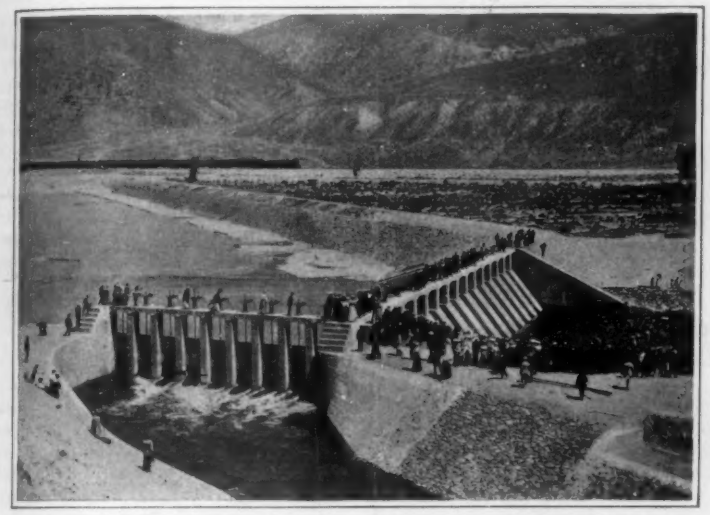
On the Huntley project in Montana, the main canal reaches a point where topographic conditions require that it be dropped to a lower level to avoid a long stretch of broken country; the power generated by the flowing water at this drop is utilized for pumping a portion of the water to an elevation considerably higher than the main canal, which it would not have been feasible to cover by gravity. This is accomplished by the device of "dry pumping" in which the flowing water is received in an inclosed casing containing a large machine which consists of a turbine water-wheel and a centrifugal pump combined as one machine, on one shaft, in one casing, and the water received is divided into two parts, one of which emerges from the turbine wheel at the lower level and is thus used for irrigation, while the other portion is raised to a high level—much higher than the main canal—and used there for irrigation.

On the Yakima project in Washington a similar result is obtained by a battery of 11 large hydraulic rams.

On the Salt River project the power developed at the storage dam is converted into high-voltage electric current, and transmitted to the valley, where the fertile land greatly exceeds the water supply, and the latter is increased by pumping from a large number of wells distributed throughout the region where ground water is known to exist. In this way about 40,000 acres of land which could not otherwise be irrigated, is added to the area of the cultivated land.

A portion of this pumped supply is utilized in relieving the needs of the Indians on the Pima Reservation, whose industry and worth, and whose urgent needs, have been so much discussed in the public prints.

On the Minidoka project in Idaho a diversion dam about 50 feet in height has been built to divert the water upon the neighboring valleys, and about 80,000 acres of good land is thus irrigated by gravity. It is necessary to allow a large quantity of water to flow past the dam during the irrigating season, for the satisfaction of irrigation appropriations at points further down the stream. This water is taken from the dam under a head of about 46 feet, and by means of hydro-electric machinery is converted into electric current and transmitted about 15 miles to the southwestward, where it is used for pumping water from the main canal to irrigate about 50,000 acres of land too high to be reached by gravity. This is some of

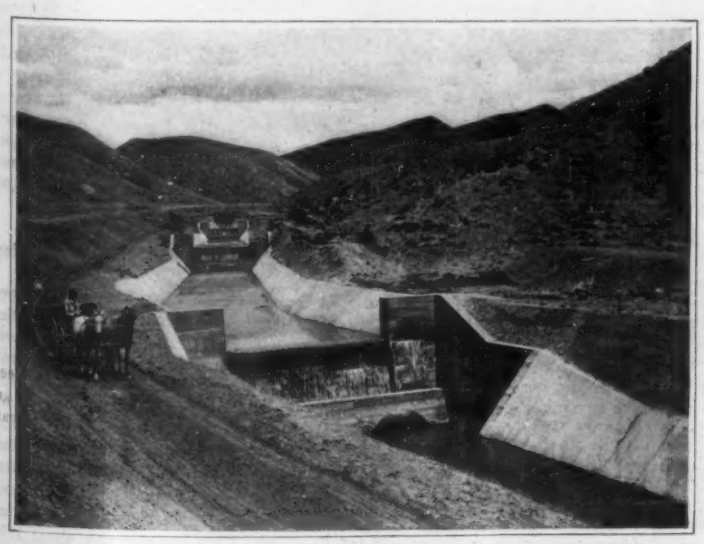


Truckee-Carson project, Nevada. Diversion dam, with gates closed.

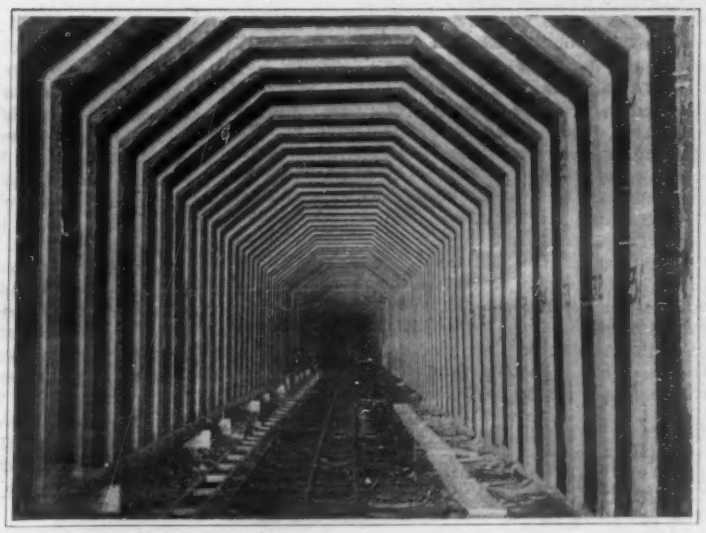
Minidoka project, Idaho. Dam and regulating devices.

Okanoga project, Washington. Concrete-lined canal.

Klamath project, Oregon. Intake gate and concrete canal.



Uncompahgre project, Colorado. South canal. Sixteen series of drops.



Uncompahgre. This six-mile tunnel conveys Gunnison River through mountain.

Department of the Interior, United States Reclamation Service—Results of Reclamation Work from June 30th, 1902, to December 31st, 1910.

Projects.	Irrigable Lands, Acres.				Present Available Reservoir Capacity, Acre-feet.	Canals, Miles.				Tunnels.	
			Area Irrigated Season of 1910.			Capacities in Second-feet.					
	Estimated Total for Completed Project.	Area for Which the Service Can Supply Water Season of 1911.	Under Water Right Applications.	Under Rental Contracts or Other Arrangements.		More than 800.	From 201 to 800.	From 50 to 200.	Less than 50.	Number.	Total Length, Feet.
Arizona, Salt River	220,000	150,000	.....	131,000	1,284,000	32	64	54	349	26	10,980
Arizona California, Yuma	90,160	16,000	600	8,000	.....	2	.....	17	81	.....	.....
California, Orland	14,000	14,000	.....	700	46,000	.....	.....	23	70	.....	.....
Colorado, Grand Valley	53,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado, Uncompahgre Valley	140,000	30,000	.....	21,000	.....	12	15	41	86	6	33,314
Idaho, Boise	243,000	128,000	.....	33,377	170,000	88	59	150	291	.....	.....
Idaho, Minidoka	124,700	101,000	35,000	11,000	53,000	12	21	119	406	.....	.....
Idaho, Snake River Stor. Unit	.....	.....	.....	.....	350,000	.....	.....	.....	.....	.....	.....
Kansas, Garden City	10,677	.....	.....	.....	.....	.....	.....	2	2	.....	.....
Montana, Blackfeet	133,000	2,000	.....	.....	.....	.....	.....	30	7	.....	.....
Montana, Flathead	152,000	19,000	.....	2,000	3,400	.....	.....	26	112	1	974
Montana, Fort Peck	132,000	2,500	.....	.....	3,900	.....	.....	12	15	.....	.....
Montana, Huntley	32,521	28,805	8,000	.....	.....	.....	9	19	165	3	2,654
Montana, Milk River	215,000	7,870	.....	.....	.....	6	.....	12	23	.....	.....
Montana, St. Mary Stor. Unit	.....	.....	.....	.....	.....	10	.....	.....	.....	.....	.....
Montana, Sun River	300,000	16,366	4,000	194	.....	7	1	18	100	1	581
Montana-North Dakota, Lower Yellowstone	63,780	40,179	8,655	.....	.....	10	42	19	124	.....	.....
Nebraska-Wyoming, North Platte	120,000	97,630	41,246	8,195	1,025,000	90	9	44	435	3	984
Nevada, Truckee-Carson	206,000	50,400	27,085	472	200,000	42	62	79	102	4	2,840
New Mexico, Carlsbad	20,255	20,255	13,105	50	35,000	.....	5	25	130	.....	.....
New Mexico, Hondo	10,000	.....	.....	1,300	40,000	.....	3	2	45	.....	.....
New Mexico-Texas, Rio Grande	160,000	.....	.....	.....	.....	.....	6	.....	.....	.....	.....
New Mexico-Texas, Lensburg Unit	.....	25,000	.....	25,000	.....	.....	.....	.....	.....	.....	.....
North Dakota, Missouri River Pumping Buford-Trenton Unit	12,500	4,000	440	.....	.....	.....	.....	1	14	.....	.....
North Dakota, Williston Unit	12,000	8,047	2,000	.....	.....	.....	.....	3	43	.....	.....
Oregon, Umatilla	25,000	17,282	2,500	74	30,000	.....	25	24	78	1	34
Oregon-California, Klamath	127,000	90,400	27,108	.....	602,000	9	1	34	99	1	3,397
South Dakota, Belle Fourche	100,000	47,498	15,410	.....	75,000	7	19	65	200	1	1,306
Utah, Strawberry Valley	60,000	.....	.....	.....	.....	.....	8	.....	.....	3	12,044
Washington, Okanogan	10,000	10,000	3,400	1,000	15,000	.....	.....	12	29	1	395
Washington, Yakima Storage Unit	.....	.....	.....	.....	91,000	.....	.....	.....	.....	.....	.....
Washington, Sunnyside Unit	100,000	65,000	6,000	45,000	.....	25	15	40	280	.....	.....
Washington, Tieton Unit	35,050	19,378	.....	1,695	.....	.....	12	23	112	.....	10,960
Wyoming, Shoshone	155,000	34,595	14,349	392	458,100	10	2	28	158	11	19,246
Totals	3,095,643	984,735	209,868	293,391	4,568,500	341	373	925	4106	68	99,595

III.—Summary of the Reclamation Projects

THE following is a brief recapitulation of four signed articles written by the supervising engineers of the various projects. Unfortunately, the original articles are too lengthy for inclusion in the present issue. They are published in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, *together with a large number of illustrations from photographs furnished by the Reclamation Service.*—ED.

Washington Division. Charles H. Swigart Supervising Engineer.

The Washington Division comprises all of the State of Washington and the extreme northern part of Idaho. The Reclamation Service has completed one project, the Okanogan, and is now constructing the Yakima project. OKANOGAN PROJECT.—The Okanogan Project, now completed, provides for the irrigation of land in the valley of the Okanogan River. Water is stored in Salmon Lake, and in Conconully Reservoir, the two having a combined capacity of 15,000-acre feet. An earth dam a thousand feet long, 64 feet high, has been built across Salmon Creek. This is the only dam constructed by the hydraulic hill method by the Reclamation Service. The irrigable land, amounting to about 8,650 acres, is of volcanic ash, sand and gravel. The building charge per acre is $65, and the annual maintenance and operation charge is $2. YAKIMA PROJECT.—The Yakima Project embraces all the land in the Yakima Valley that can be watered from the Reclamation Service works, together with some lands in the Columbia Valley, near the mouth of the Yakima River. This project, for convenience, is divided into the Storage, Kittitas, Tieton, Sunnyside and Wapato Units, with the High Line, including the Benton Unit, or the Benton Unit alone, as alternative propositions. The Storage Unit includes works for impounding the flood waters of the Yakima and its tributaries, in five separate reservoirs, which will have a total capacity when fully developed of approximately 928,000 acre-feet. The Kittitas Unit, for which surveys have been made, embraces 62,000 acres of land on both sides of the Yakima River. The Tieton Unit, containing some 34,500 acres, lies west of the city of North Yakima, and between the Naches River and Ahtanum Creek. The Sunnyside Unit, containing 100,000 acres, receives its water from the Yakima River, just below Union Gap. The Wapato Unit consists of 114,000 acres on the right bank of the Yakima River, just below Union Gap. This land was allotted to the members of the Yakima tribe of Indians. The Benton Unit includes from 120,000 to 150,000 acres of land on both sides of the Yakima River, near its junction with the Columbia. The High Line Canal will, if constructed, furnish water for the lands on the left bank of the Yakima River above existing canals.

Northern Division. H. M. Savage Supervising Engineer.

The Northern Division comprises the States of Montana, and North Dakota, and South Dakota, and northern Wyoming, and includes the Missouri River drainage basin, with the Yellowstone River in Montana and the Big Horn River in Wyoming. Within this area the construction of seven Reclamation Service irrigation projects has been authorized. Construction has progressed to the extent that at least one unit of each project has been completed, and all the large feature structures on several of the projects are now constructed.

The flat grade of the Missouri River rendering the construction of gravity irrigation canals impossible, the construction of the NORTH DAKOTA PUMPING PROJECTS was found to be dependent upon the development of power from the ample fuel supply in local lignite beds, and its transmission electrically to operate centrifugal pumps mounted on floating barges on the Missouri River. The barges are taken out of the stream at the end of the season and again launched at the beginning of the next irrigation season. THE LOWER YELLOWSTONE PROJECT.—The Lower Yellowstone Project in eastern Montana and North Dakota covers 60,000 acres, and is nearly completed. It includes a timber crib rock-filled diversion dam, which provides an overflow depth of 25 feet. The Yellowstone River at the site of this dam has a maximum flood flow of 160,000 cubic feet per second. THE SHOSHONE PROJECT in northern Wyoming will reclaim 164,000 acres of land, with a feasible extension to cover 300,000 acres. The principal features are the Shoshone Dam, the highest masonry dam in the world (328.4 feet), which regulates the discharge of the two Shoshone rivers, and whose reservoir is now filled to the spillway, and the Corbett Tunnel, three and a half miles long, with a discharge capacity of 100,000 cubic feet per second. THE HUNTLEY PROJECT on the Yellowstone River has an area of 32,000 acres, of which 28,000 acres is now settled. The success of the Huntley settlers is unprecedented. The crops on the irrigated area the second season realized a value of $25 per acre. The project has now thirteen public schools and six church organizations. THE SUN RIVER PROJECT, west of Great Falls, is the largest in the division, the available water supply being from 200,000 to 300,000 acres. It is now entering on its third season of operation. The main features are high storage dams and a canal of 2,500 cubic feet per second capacity. THE MILK RIVER PROJECT in northern Montana depends on the waters of the St. Mary drainage basin, which discharges into Hudson Bay. It involves 200,000 acres of land, and four million dollars has recently been provided for carrying on the work. INDIAN RESERVATION IRRIGATION PROJECTS.—The Reclamation Service is constructing works on the Flathead, Black Feet and Fort Peck Indian reservations, each of which has an area of about 150,000 acres of irrigable land. Most of this has been allotted to the Indians in severalty, and the receipts from the sale of excess lands will return the cost of the irrigation works. The ultimate development of the FLATHEAD PROJECT involves the construction of fifteen storage reservoirs, and the construction and operation of a hydro-electric pumping plant.

Idaho District. F. E. Weymouth Supervising Engineer.

The Idaho District embraces that portion of the Snake River Basin from its headwaters in the Yellowstone National Park in Wyoming to its confluence with and including the Salmon River, a total area of about 90,000 square miles. It embraces the Boise, Minidoka and Snake River Storage projects. BOISE PROJECT.—This embraces 243,000 acres of land on the south side of the Boise River between its confluence with the Snake River and the city of Boise. The principal engineering features are: First, a storage dam, 1,025 feet on the crest and 340 feet high, which will be the loftiest dam in the world. It will impound 207,000 acre-feet of water for use in the low water period, on lands in the upper portion of the project. The lower portion will be supplied from the Deer Flat Reservoir, which is filled by water diverted from the Boise River, and will have a capacity of 170,000 acre-feet. The main south-side canal for carrying the water has a capacity of 3,500 feet per second, and is forty miles in length, six of which are lined with concrete. MINIDOKA PROJECT.—The principal engineering feature of this project, which embraces an area of about 132,000 acres on both sides of the Snake River in central southern Idaho, are the Minidoka Dam, headworks, power plant, and pumping stations. The dam, 736 feet long and 86 feet high, is of the rock-filled type. It is flanked by the power plants and north side headworks on the north and a solid concrete spillway 2,400 feet long, and the south side headworks on the south side. The power plant includes five turbo-generators of 1,500-kilowatt capacity, which, during the irrigation season, pump water to 47,000 acres of high land, and also serve to furnish the towns on the project with light, power and heat. Nearly all of the business houses and many of the private houses in the thriving towns of Rupert, Heyburn and Borley use electrical energy for heat. The three pumping stations on the south side lift the water in three stages to a total height of 90 feet. By means of reinforced concrete piers, the water of the reservoir can be raised five feet, thus increasing the storage capacity and the available head on the turbines. SNAKE RIVER STORAGE.—This contemplates the storage of flood water of the rivers in reservoirs, so as to regulate its flow to conform to the needs of irrigation and power. Jackson Lake Reservoir, just south of the Yellowstone National Park, is completed. A reinforced concrete dam and an earth dike form a reservoir of 380,000 acre-feet capacity.

Intermountain District. R. F. Walter Supervising Engineer.

The work of the Intermountain, sometimes known as the Central District of the Reclamation Service, covers a territory in which irrigation has been employed as a means of distributing moisture to grow crops since the earliest settlement by the pioneers, who turned their attention from the search for gold to the work of diverting the waters from the streams onto the barren land. They were so successful that agriculture quickly overshadowed the mining industry. Some one suggested the storage of the flood waters in reservoirs, for use after the streams had been reduced in flow. This work began about 1890, since which time thousands of storage basins have

(Continued on page 156.)

The Conservation of Fishery Resources

How Legislation May Prevent Ruthless Waste

By Dr. Hugh M. Smith, U. S. Deputy Commissioner of Fisheries

NEARLY forty years before conservation had become a household word in America, one branch of the federal government had entered on a course of action having for its direct object the maintenance of the supply of useful water creatures. That work has continued uninterruptedly and with annual augmentation to the present time; and in it the Federal Government as represented by the Bureau of Fisheries has co-operated for many years with the fishery departments of various States. Among all of our natural resources there are none that have been more flagrantly abused, none that are more in need of intelligent attention at the hands of conservators, and none that will respond more readily to decent treatment than the fishes and other inhabitants of our coastal and interior waters.

Success of Fish Culture and Acclimatization.

The acclimatization of fishes in all parts of the country has been a potent supplement of fish culture proper and a valuable factor in conservation by relieving the strain on native fishes and by making exhausted waters again yield their quota of human food. Among the noteworthy results of the introduction of fishes into a new environment are the cases of the shad and striped bass. These excellent food fishes are not native to the Pacific Coast but were planted there by the government more than a quarter of a century ago. The slender colonies took root, thrived, multiplied, and spread to such an extent that both of these species are now reckoned among the commonest food fishes of the western seaboard, the shad having a coastwise range of four thousand miles and the striped bass being more abundant in California than in any Eastern State. The entire cost of the introduction of these fishes into the Pacific States did not exceed $5,000. The market value of the catch to the fisherman to the end of the year 1910 exceeded $1,750,000. With the present trend of the shad and striped bass fisheries on the Atlantic Coast, it is not beyond the range of probability that the re-establishment of these fishes in eastern streams may depend on fry brought from the West.

Legislation and Regulation.

A co-ordinate if not a coequal factor in fishery conservation is legislation. For the protection of fish in interstate waters, well considered restrictive legislation, supported by local sentiment, may accomplish much; for interstate and boundary waters, or for fishes that migrate from one jurisdiction to another, legislation has often, perhaps usually, failed. The failures have been serious in some regions and in the case of some species, and afford the strongest possible argument for federal control and also regulation.

Catching and sorting the brood fish at a government trout-cultural station in the Rocky Mountains.

Various species of trout are hatched in large numbers, and numerous lakes and streams are kept bountifully stocked.

Stripping and fertilizing trout eggs at a station in the Rocky Mountains.

An event which gave promise of resulting in one of the great conservation measures of this generation was the assumption by the federal government of jurisdiction over the fisheries of the waters contiguous to the United States and Canada from Passamaquoddy Bay to Fuca Strait, followed by the conclusion of a treaty between the United States and Great Britain under which joint fishery regulations were to be drawn up, ratified, and enforced by the two countries. This assumption by our government of jurisdiction that had formerly been exercised by the States was undertaken reluctantly and only after protracted evidence of the inability of the States to enact and enforce legislation that was harmonious and adequate. It is therefore very unfortunate for the welfare of these extensive fisheries that the recommendations of the special commission appointed under the treaty have not been put into effect.

Whitefish of the Great Lakes.

The case of the whitefish of the Great Lakes is serious, and radical action is necessary to arrest a decline that has been in progress for many years. The regulations and restorative measures provided for the treaty would undoubtedly prove a boon to the whitefish fishery and would soon convert a dwindling industry into a flourishing one.

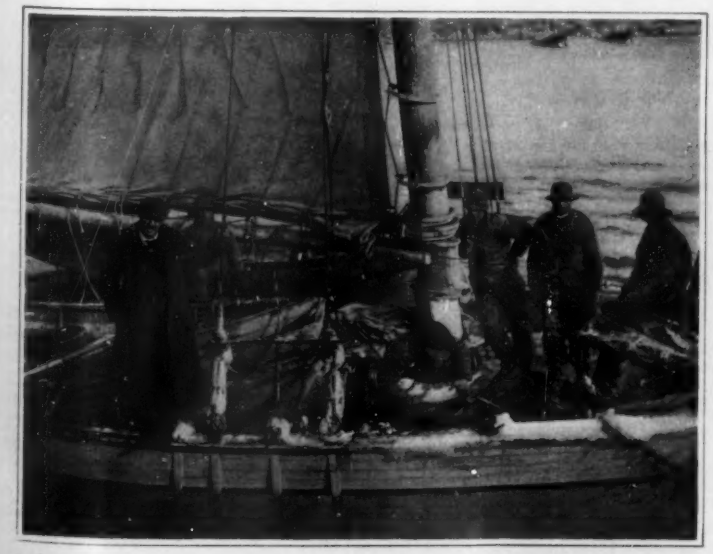
The fact that the supply of whitefish has not been maintained even at the reduced point reached in 1880 or 1890 has resulted in the direct loss of many million dollars to the fishermen and the indirect loss of many hundred thousand dollars to Federal and State Governments because of their abortive efforts to restore by artificial propagation and the enforcement of restrictive legislation. There is no fish that has been hatched artificially in larger numbers than the whitefish, while enough legislation has been addressed to it to sink a battleship. The catch has declined eighty per cent in twenty years, showing how powerful are the anti-conservation forces in operation.

There is absolutely not a single valid reason why the abundance of this great food fish should not have remained practically unimpaired for untold generations and at the same time vast quantities have been caught for market. The average number of eggs laid by a whitefish is 25,000. All that nature required, all that the unimpaired perpetuation of the fishery demanded, and the least that common sense could have granted was that a single pair of fish from the 25,000 eggs should have been permitted to reach maturity and spawn.

Oysters and Sponges.

After a precarious existence of many years, the oyster has gradually come under the influence of cultivation, and along much the greater part of our extended coast its conservation is an assured fact and need never occasion any further concern. The finan-

(Continued on page 155.)



An important source of cod eggs for the New England hatchery is the catch of the market fishery. Spawn-takers board the vessels, overhaul the fish, and save the eggs of such as are ripe.

Government employees collecting cod eggs on a fishing vessel.

The entire water front was once covered with seals, whereas in recent years there have been enough mature cows resorting to this place to form only two or three small harems.

A depleted fur-seal rookery.

The Use and Waste of Our Coal Supply

(Continued from page 139.)

These problems are intricate, and their satisfactory solution doubtless remote, but they are of such importance as to be worthy of the best efforts of the Government and of its private institutions and individual citizens.

In engineering and architecture we hide our ignorance as to the strength and other properties of structural materials behind the well-sounding phrase, "factors of safety." In these important and intricate fuel problems we hide our ignorance and rest our laurels concerning these losses under the equally comforting expression, "transformation of energy." What American industry needs is technical information, accurate fundamental data, such as comes from varied, extended, continuous, well directed, and scientific research.

Each recent year has witnessed some advance in the line of greater fuel efficiency; and while each advance has been small, the aggregate has during the past decade raised the percentage of heat units converted into mechanical work from five or six to nine or ten, and slightly more in a few cases. The gas producer and gas engine, the steam turbine, and the improved reciprocating engine, represent steps in this advance. So does also the

Coal car is picked up bodily, turned over, and discharges to chute.

Much coal is lost as dust during handling.

development and introduction of the several types of automatic stokers; these latter contributing to efficiency and at the same time lessening the smoke nuisance from modern power plants.

These automatic stokers and special grates have further contributed to the conservation of resources by making possible the more efficient burning of fine or slack coal, which formerly was relegated to culm piles as waste, and as such to be burned in the open air. Briquetting is making another contribution along the same line. Another step in the direction of practical conservation, cleanliness, and hygiene—and one that should be pushed more rapidly—is the location of the great power plants at the mines, and the burning there, either in gas producers or specially constructed furnaces, of the low grades of coal now thrown away because they will not bear transportation; and the electric transmission of the power so developed to adjacent cities, towns and isolated plants.

I look forward to a time—and it cannot, I believe, be far distant—when ample supplies of electricity so generated and brought into our factories and our homes will not only give us light and power, but will also cook our food and warm our houses.

Two other marked advances in the economic utilization of coal deserve mention because of both their extent and their far-reaching importance; one is the large beginning in the manufacture of by-product coke for the latest steel plants of the United States Steel Corporation, including the saving of such valuable by-products as creosote for the preservation of timber, and sulphate of ammonia, so largely used in the fertilizing of crops. The other is the use in large gas engines of the blast furnace gases that formerly were entirely, and in many places are still largely wasted. The losses in these two fields, added to the shameful waste of natural gases, still aggregate yearly from $50,000,000 to $100,000,000; but improvements are under way in all these lines.

How These Mining Losses May Be Reduced.

No one questions the fact that these losses are real; nor are there any serious differences of opinion as to the proposition that these losses should be avoided. Just how this best can be done is another matter, and one about which a difference of opinion may naturally arise. The situation is full of interest; full of problems for the statesman, the engineer and the economist, the consumer and the producer. It involves the very essence, the purpose and the practicability of the movement for the conservation of resources.

The case may be stated as follows:

We have but the one supply of coal, and this supply is essential to both the future and the present welfare of the nation. At the present increasing rate of use and waste of this supply, it will be used and destroyed while the nation is yet in its youth. By mining and using this coal more efficiently, the life of the supply may be extended indefinitely, and both the present and future welfare of the nation thus properly safeguarded. The coal operator does not practise wasteful methods by preference. He is, however, operating under a system that encourages and even renders inevitable these wasteful practices; and for which system the public itself is largely responsible.

A Federal statute makes it impossible for the coal producers to co-operate or combine with a view to fixing a common or non-competitive price for coal at the mine. The demand for coal during the winter season of each year being much in excess of that during the warmer months, and the entire lack of storage facilities at the mines requires for this cold weather demand a mining capacity much in excess of that necessary for the summer needs. Under such a system there is constantly in progress a fierce struggle for business, and a reduction to prices so low that they often fail to cover the actual cost of production—so low that safe and clean mining is discouraged and even rendered impossible. Meanwhile, no two States have similar mining laws for the protection of life and property, nor will any State enact, or enforce, if it enacts, drastic legislative requirements, for if it does it thereby places its own mine operators at a serious business disadvantage in the sharp competition with operators in other States.

The remedy is easily stated, but not easily developed. The cut-throat competition should give place to a reasonable combination under such Federal or uniform State control of prices as would guarantee reasonable returns on mining investments, and require mining practice in which both accident and waste are reduced to an absolute minimum. This regulation and readjustment should be extended so as to include the freight and terminal agents' charges; and if this be properly done, safe and clean mining may be realized without material increase in the cost of coal to the ultimate consumer.

If to the American people the doctrine of conservation is a thing of substance and not a dream; if those of us who today are wastefully luxuriating in the abundance of inherited resources, have seriously at heart the rights and the welfare of those that are to come after us; if we are really in earnest about safeguarding the lines of the more than a million miners who labor underground for our comfort and welfare, we should enact and enforce the Federal and State legislation necessary for the accomplishment of these ends. We should render possible the business-like reorganization of this great basic industry. We should see to it that this underlying economic basis is sound, whether judged from the standpoint of the individual or the nation—from the standpoint of the present or future welfare of the nation.

The Vibrations of Metals

IT has been contended that solid metals may reveal by their structure the vibrations to which they have been subjected. In explaining this phenomenon, experiments were made in England to show that a beautiful wave structure can be imparted to the surface of mercury by the vibrations of a tuning-fork, and that even the surface of solid lead which has been subjected to similar vibrations possesses a structure resembling that of a vibrating surface of mercury. Mild steel was defined as a "solid solution" of iron and carbon, free from cinders. Metallurgists have doubled the strength of steel as it was known in early days.

Iodide of nitrogen, a black powder, is one of the most dangerous of all explosives. When dry, the slightest touch will often cause it to explode with great violence.

There appears to be a certain rate of vibration which this compound cannot resist. In experiments to determine the cause of its extreme explosiveness, some damp iodide of nitrogen was rubbed on the strings of a bass viol. It is known that the strings of such an instrument will vibrate when those of a similar instrument, having an equal tension, are played upon.

In the present case, after the explosive had become thoroughly dry upon the strings, another bass viol was brought near and its strings were sounded. At a certain note the iodide of nitrogen on the prepared instrument exploded.

It was found that the explosion occurred only when a rate of vibration of 60 per second was communicated to the prepared strings. Vibration of the G string caused an explosion, while that of the E string had no effect.

The question is often asked, What force least expected does the greatest damage to buildings? One architect's answer to this question may be a surprise to those who do not understand that it is the regularity of vibration that makes it powerful.

"I venture to say," remarked this architect, "that you would never suspect that violin-playing would injure the walls of a building. Yet it certainly does. There have been instances when the walls of stone and brick structures have been seriously damaged by the vibrations of a violin. These cases are, of course, unusual, but the facts are established.

"The vibrations of a violin are really serious in their unseen, unbounded force, and when they come with regularity, they exercise an influence upon structures of brick, iron or stone. It follows, of course, that there must have been continuous playing for years to cause the loosening of masonry or to make iron brittle, but it will do so in time."

LEGAL NOTICES

PATENTS

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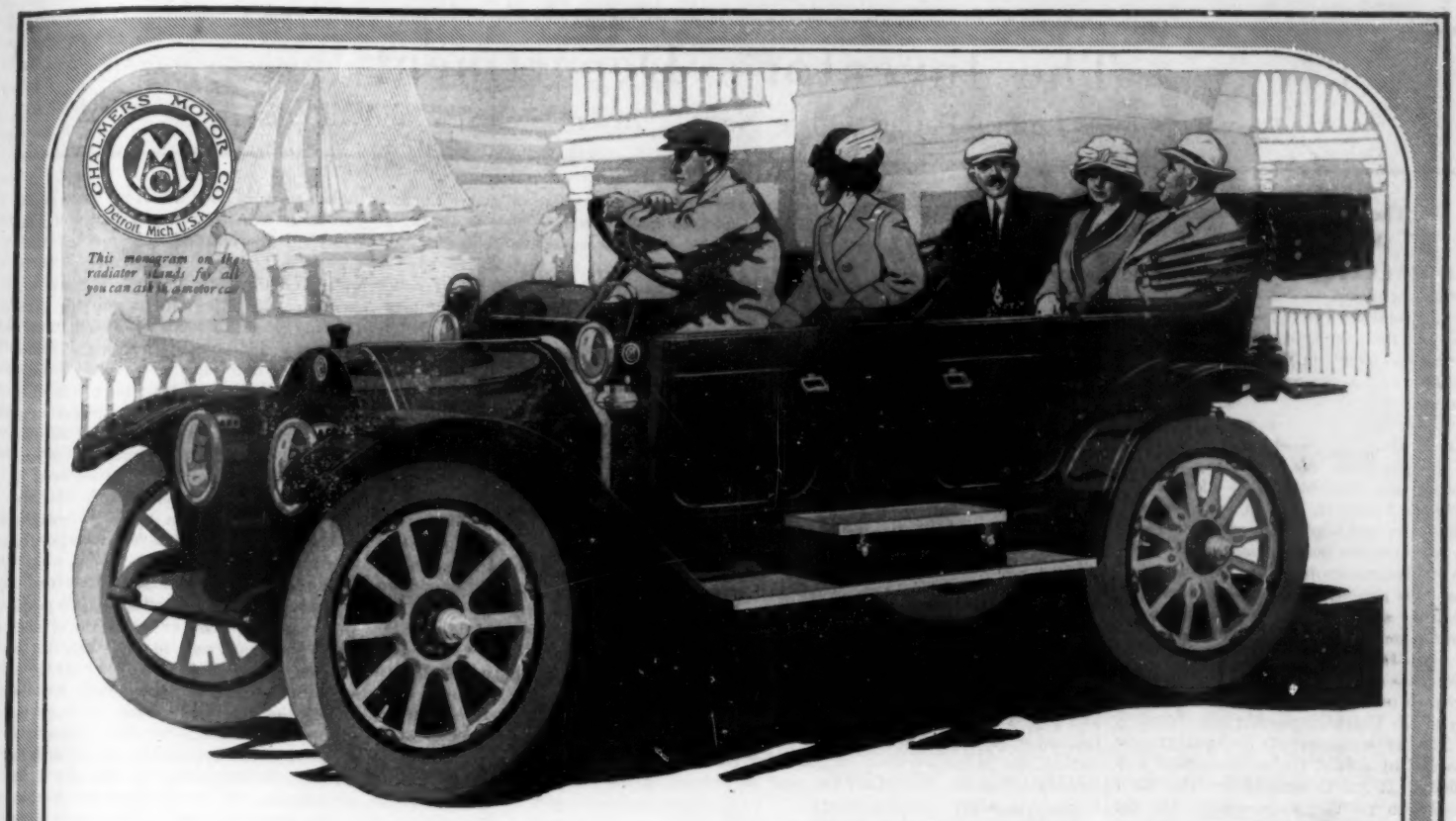
THE EAGLE AEROPLANE CO., Brunswick, Ga., incor., capital stock $100,000; central factory with branches and training ground in South and West, offers business connections to the right men with some means. Mechanics, aviators and wireless operators wanted.

METAL NOVELTIES MANUFACTURED.—Thoroughly equipped factory with every facility and up to date device for manufacturing metal novelties. Especially well equipped for press work. The Horton Manufacturing Company, Bristol, Conn.



This New, Big, Self-starting Chalmers "Thirty-six"—$1800

THINK of a new, high powered Chalmers car with a Self-starter as regular equipment—for $1800! No more cranking, no more bother. Just push a button on the dash with your foot, and away goes your motor.

That isn't all. This car has a long stroke motor (4¼" x 5¼", developing 36 to 40 h. p.); four forward speed transmission; Bosch dual ignition; 36-inch by 4-inch tires; Continental Demountable rims; Mercedes type honeycomb radiator; dash adjustment for carburetor.

Furthermore this car has bigness, strength, proved durability, beauty, fine finish, comfort. Still further, it is a *Chalmers* car. On the radiator is the famous blue and white monogram.

And the price, including all these unusual features of value, is $1800.

A man at the circus for the first time viewed in amazement the giraffe. After looking the animal over for some time and inquiring if it had a name, he turned shruggingly away saying, "There ain't no such animal."

Many motorists, hearing of the Chalmers "Thirty-six" for the first time, then learning the price, have felt much the same way.

But they are wrong. There really is such a car as the Chalmers "Thirty-six," with the features named above—for $1800.

You can see this car now at our dealer's store near you. And it will look better to you there than it does in this advertisement. See it. Ride in it. Place your order as early as you can because there is sure to be an over-demand.

Ideal Car for the Farmer

This is an ideal car realized. A car perfectly adapted to the needs of the up-to-date farmer. The long stroke motor gives all the power and speed you can want, without useless burning of gasoline. The four forward speed transmission gives perfect flexibility for hills, sand, traffic and straightaway. Big tires, 36-inch by 4-inch, give riding ease and insure low tire upkeep bills.

The "Thirty-six" is heavy where weight means maximum strength, but there is no useless weight. We claim that this car is lighter than any other car of the same power, roominess and strength, and that it is stronger than any other car of the same weight.

This car overcomes the inconveniences of all preceding cars. The Chalmers Self-starter, air pressure type, does away with the trouble of cranking. Big tires and Continental Demountable rims rob punctures of their terrors.

Given Severe Tests

While the "Thirty-six" has every up-to-the-minute improvement, still there is not a single untried principle or part in its makeup. In November, 1910, we started three of these cars on the road to test them—one in the mountains of Pennsylvania, one in the sands and heat of Florida, and one in the varied conditions of the Middle West. They were run an average of 10,000 miles each before we O. K.'d the model for manufacture.

Here is a big car—big radiator—big hood—big wheels and tires—big body with big roomy seats—big, strong frame—big axles—big all over, and yet it isn't a cumbersome, costly upkeep car.

Not only has this car all of these unusual features of construction and convenience, but with them it has beauty. It is a *fine* car.

Compare With Many Cars

There are bigger cars than the "Thirty-six" and smaller ones. Cars of more power and of less. Heavier cars, lighter cars. There are higher priced cars and lower priced cars. And yet we ask you to consider this car on the basis that it is the most nearly ideal car for the farmer of all that are made.

Take the size, the power, the conveniences, the construction, the comfort, the beauty *and the price* into consideration in comparison with the same features on all other cars, and see if you do not conclude that in the Chalmers "Thirty-six" we have come most nearly to realizing the ideal car for the greatest number of people.

A Vote of Confidence

Public announcement of this car was first made on July 6th. Prior to that date, dealers had signed contracts for all we can make. They were anxious to sign up for twice the number, but we had to allot just so many to each territory. Since our announcement appeared, the Sales Department has received requests from more than two hundred other dealers, asking for the privilege of handling the Chalmers line in their section.

We asked dealers this year for exclusive representation for Chalmers cars in their price classes. Not one dealer was unwilling to grant this request, dozens of them giving up other lines in order to hold the Chalmers. The vote of confidence which experienced dealers have given this new Chalmers car is one of the best possible guides for the individual buyer.

"30" Fully Equipped, $1500

The Chalmers "30" and Chalmers "Forty" are continued for 1912 and offer greater values than ever before because of the improved methods of manufacture and added equipment. The "30" sells for $1500, including magneto, gas lamps, Prest-O-Lite tank, Chalmers mohair top, and automatic windshield. Last year this car so equipped brought $1750. The "Forty" sells for $2750, including the same complete equipment.

More than a year ago, as the heading of an advertisement, we used an expression which was frequently heard in automobile trade circles: "This Is Another Chalmers Year." It was true then, and we repeat it now, for it is more apparently true now than in any other year. "This is another Chalmers year."

1912 catalog will be mailed on request.

Chalmers Motor Company, Detroit, Mich.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The Millionth Patent

By William N. Taft

UNMARKED by any pomp or ceremony and with a lack of ostentation that seemed totally inappropriate to the importance of the occasion, the one millionth patent was issued on Tuesday, August 8th.

The wheel of chance which decided the recipient of the epoch-making patent—for the record number was awarded to the patent which happened to be on the top of the pile when the numbering machine passed the 999,999 figure—decided in favor of Frank H. Halton, of Cleveland, Ohio, who had applied for exclusive rights to manufacture and sell an improvement on inflated automobile tires. It was fitting that this patent, in itself a monument to progress, should have been awarded to an improvement on the automobile, for there is probably no single recent invention which has done so much to mark American progress or to show the world the prosperity of the United States.

The presentation of the patent was marked by a most undue democratic simplicity. It was thought at first that there would be no official recognition of the event at all, but Mr. Halton came on from Cleveland to receive the patent at the hands of Commissioner Moore. The fact that the Secretary of the Interior had made plans to tour the reclamation projects of the West during August precluded his attending the presentation of the patent, and he evinced much disappointment at not being able to be present.

The mere statement that the issue of patents has passed the million mark is, in itself, enough to provoke wonder, but a comparison of the number of patents issued in other countries—centuries older than the United States—brings to light many interesting figures. France comes nearest to the United States in the number of licensed inventions, 430,000 being approximately the number of her patents. Great Britain is next with 416,000; Germany has issued 236,000; Belgium, 228,000; Canada, 126,000; Italy and Sardinia, 94,000, and Austria-Hungary, 68,000. All the other countries of the world have issued less than 60,000 patents each, so that the United States may easily be said to have licensed more inventions than any two nations put together, and that her total exceeds that of Great Britain, Germany, Belgium and Italy by several thousand.

Perhaps it is because the "American" is truly a cosmopolite, a mixture of all the bloods of the world, that this nation has so far surpassed others in inventions, but true it is that the majority of the important discoveries of science and the greatest labor-saving machines first saw the light of day in the United States and that the documents granting their inventors the exclusive right to manufacture and sell them are to-day reposing in the Patent Office at Washington.

Among the historic documents in the Patent Office library are the specifications and models for the steamboat, the telegraph, the telephone, the cotton gin, the mowing and reaping machine, the improved automobile, the aeroplane, and countless other machines the invention of which has lightened the labor of the world and improved its method of locomotion, correspondence and living to an almost incalculable degree.

There exists in the Patent Office library at Washington the first patent ever issued in this country, shortly after the close of the Revolution. It is a queer document, this first patent, quaintly worded and with many a turn and twist of chirography peculiar to our forefathers. It was issued to Samuel Hopkins, July 31st, 1790, for a device for making pot and pearl ashes. The archives of the department show that the issuance of a patent in those days was a state occasion. The President and cabinet met in solemn conclave and, after having deliberated upon whether it was proper for the inventor to have the sole right to the manufacture of the child of his brain, presented him with the papers bestowing this privilege upon him. Hopkins was warmly congratulated by President Washington and the event was recorded in all the diaries of those present.

Thus it was for some time afterward. Every inventor had to submit his appeal for a patent directly to the President, and it was acted upon by the entire cabinet. The consequence was that patents came few and far between and the year 1790 saw only three of these documents issued. Besides the one to Hopkins, one was granted to Joseph S. Sampson for the manufacture of candles and the other to Oliver Evans for the manufacture of flour and meal. All three of these were issued and signed by George Washington. Several other patents were issued and signed during the administration of the first President, but the records are not clear as to their number.

Washington, himself a patron of the arts, was liberal and generous in his rulings concerning the issuance of patents, but President Jefferson, fearing that government grants might have the effect of promoting private monopolies, was particularly strict in his censorship of patents.

Dr. William Thornton, an Englishman by birth, and formerly a clerk in the State Department, was the first Superintendent of Patents appointed. It was his duty to see that all the applications for patents were made in the proper form and that it was right that they should be granted. The actual issuance of the papers, however, was still retained in the hands of the President and the cabinet. Dr. Thornton's salary at the time he was first appointed was $1,400 a year. His term of office dated from May, 1802, and lasted twenty-four years.

The Patent Office as it exists to-day was established by an act of Congress of July 4th, 1836, and the first Commissioner of Patents was Henry L. Ellsworth, of Connecticut. It was coincident with the establishment of the Patent Office that the searching system came into vogue. This consists in looking through all the files of the office to see if any patent similar to the one applied for has previously been granted. This had not been done previous to 1836, as no adequate force had been available to perform the work.

The year 1836 also marks the commencement of the present series of patents, numbered consecutively. Before this time 9,902 patents had been issued, but no record had been kept of their consecutiveness. These were, therefore, disregarded in the establishment of a new system and the first patent of this series was awarded to John Ruggles, July 13th, 1836, for a locomotive engine. It is rather a strange coincidence that Patent No. 1 and Patent No. 1,000,000 should both have been awarded to improvements in the foremost modes of locomotion of their times and that these inventions mark the progress of two machines which represent the highest form of power transference then known.

From 1836 to the present time the number of patents issued has been steadily increasing until at the present time it is not unusual to see from 500 to 700 issued during a single week. An example of the enormous increase in the number granted can be found in the fact that Patent No. 500,000—awarded to E. S. Hyde for an improvement on sewerage—was issued on June 20th, 1893—only eighteen years ago! Thus it took fifty-seven years to accumulate the first half million patents and only eighteen years to gather the last half million. Truly is this a wonderful growth, both in inventive ability as well as in recognition of this ability by the government, for in the first two decades of the system very few patents, comparatively speaking, were issued, the Jeffersonian prejudice against government aid of private monopolies not having died.

For each patent issued the government charges a fee of $35—$15 upon the filing of the application and $20 upon notice that the same has been granted, regardless of the length of the specifications or the complexity of the invention. That this charge is extremely reasonable may be seen from the fact that every patent of the million and more stored away in the vaults of the department has to be gone over to discover if the application will conflict with any existing patent, or if the idea is such that a patent cannot be granted on it. This work, through a complicated system of filing, is to-day rendered comparatively easy, though two decades ago it was considered a tremendous task, although the patents were not half so numerous at that time.

From the first Superintendent of Patents in 1802 to the present Commissioner of Patents is a long step. Many changes have taken place during this time, but it is considered that the Patent Office to-day presents an example of a highly specialized and finely organized institution where the papers relating to any patent may be secured at a moment's notice and where there is not much difficulty in discovering whether an invention has been patented before or whether there is any other difficulty in the way of its being patented at the present time.

When the first patent was issued the President of the United States made the grant, as we have seen, while the record was written by a clerk in the State Department. Then followed the Patent Board, composed of the Secretary of State, the Secretary of War and the Attorney General. This was continued until 1836, when the first Commissioner of Patents was appointed, and this office has remained in force until the present day, Edward Bruce Moore being the present occupant of the chair.

Mr. Moore has worked his way up to his present position from the ranks. His first position in the Patent Office was that of Patent Examiner, in 1883, and he has remained constantly in the service of the department from that time to this. Before being appointed to his present position he was sent as a special commissioner to the Paris exhibition of 1900. In 1907 he was appointed Commissioner of Patents and was sent as the special representative of the United States to the International Conference for the Protection of Industrial Property in Stockholm, Sweden, in 1908. He also served in a like capacity at the Fourth International Conference of American States at Buenos Aires, Argentina, in 1910, and was the presiding American official at the recent International Patent Conference, held at Washington.

Notes for Inventors

A Laborer's Fireless Cooker.—A workman in a western city recently made an ingenious application of the laws of chemistry to his own purpose. A few minutes before noon a laborer on one of the big buildings then being constructed, proceeded to heat his coffee for lunch without the aid of a fire or even the use of a match. He took a bottle from his pail, and with it went to the wooden contrivance in which mortar was mixed. He put about half a shovelful of sand in a corner of the mortar-bed, having previously scraped that part of the bed dry and clean. Then he took a piece of lime about as large as his two fists. He pushed the lump of lime down into the yielding sand, put his bottle upright on the lime, banked up the bottle with sand to hold it in position, and was ready for the important part of the work. Dipping about a pint of water from a barrel near by, he poured it on the molded sand easily, allowing it to percolate through the coarse grains. Putting on a little more sand to hold the bottle in position, he went back to his work. In ten minutes the noon whistle blew, and the laborer went to his fireless heater, took from it his coffee, boiling hot, in a bottle that had at no time been in danger of breaking in the heat, and proceeded to enjoy his meal.

The Lure of Invention.—The lure of invention is one that influences all people and spares no class or condition of men. From the clergyman in his study to the convict in his lonely cell, it exerts its attraction, and both are found enrolled among the list of patentees, although not so precisely identified. The stimulus is not always the hope of fee or reward, for we find the millionaire as strongly interested as the very poor. There is something in the attraction that cannot be resisted. Someone has said that writing is like flirting. If you cannot do it, no one can teach you to do it, and if you can do it, no one can keep you from doing it. So it is with invention; no one can teach you to do it, and if you have the divine afflatus, no one can prevent you from exercising it. This is fortunate; for the inventor is subjected many times to discouraging influences in the first instance. Have you ever noticed, however, the pride with which anyone will display an invention even of the simplest character? Surely this is commendable, for we all admire originality, and invention is originality, often of the highest order. While the lure may be regarded apart from the results, we cannot help realizing what a poor world this would be except for the beneficent works of the inventors of all times.

A Swimming Apparatus.—John G. Alfier and Manuel J. Maneas of Oakland, Cal., have patented No. 998,146, a swimming appliance, in which a harness is applied to the swimmer and carries at the back, near the shoulder blades, pivoted paddles which are connected up by means of cords with the legs of the user, so the motions of the legs in swimming will also operate the paddles.

A Cooper Hewitt Patent.—Peter Cooper Hewitt of Ringwood Manor, N. J., assignor to Cooper Hewitt Electric Company of New York, has issued patent No. 998,175, for improvements in the starting and operating of mercury vapor apparatus, in which is employed an hermetically sealed and completely exhausted container with a number of electrodes in it, including an anode and a vaporizable reconstructing cathode with a platinum wire sealed to the wall of the container and lying above and below the surface of the wall of the electrode, with a starting band outside the container with current supplying means and means for applying a momentary high-voltage impulse to the electrodes to accomplish the starting.

Mercury to Weight a Fishing Line.—Fishermen will be interested in a fishing line which has mercury incorporated in its texture in order to increase the weight of the line. The patent is No. 998,341, and was granted to a resident of Ben Rhydding, England.

A Self-protecting Check.—A self-protecting check is shown in a patent, No. 998,332, to Arthur J. Farmer of Grosse Pointe Farms, Mich. The check has a number of separate signature spaces, and different limiting amounts are inscribed

on the different spaces, so the signature of the drawer of the check on any space will indicate that the amount of the check is not above the amount inscribed on such space.

The Need of Bats and "Billies."—There appears to be a call for better baseball bats and improved batons or "billies" for police use. Only a few weeks ago the property clerk of one of our large cities was complaining of the breaking of the police batons when used upon the head of a resisting prisoner or when rapped upon the pavement; and now Hans Wagner, the popular baseball professional, is quoted as saying "A perfect bat has never been made and never will be." Now he may be right as to what has been, but he is rash in his prediction, for none can say what may be. It is possible that future improvements in the national game may be most pronounced in the equipment of the bats and balls.

Wanted: A Sounding Buoy That Will Sound in Still Water.—A sounding buoy which will sound when the water is still would be an important improvement. Such buoys, whether of the bell or whistle variety, are caused to operate by the movement of the water. In foggy or thick weather the water is usually still, and the buoys will not be caused to sound. Manifestly, the buoys are more useful in foggy or thick weather than when the weather is clear. Some of these buoys are large and heavy, weighing as much as twenty tons, the size and weight being necessary to compress the air for operating whistles whose tubes are sometimes as large as eighteen inches in diameter, and for storing the carbide to furnish the gas for the light, the buoys being frequently combination sound and light buoys. While the problem may be somewhat complicated, it does not seem unreasonable to think that a buoy may be provided which will sound by the movement of the water in a high sea, and will also sound when the water is comparatively still.

A Woman's Score-sheet for Pivot Bridge.—A woman's interest in bridge is shown in a patent, No. 998,167, issued to Alice N. Gardiner of Haverhill, Mass., for a pivot bridge score-sheet which has two fields, one of which is divided into sections corresponding in number to the number of players, so the names of the players and the totals of the respective players may be placed in the separate sections, while the other field is divided into sections corresponding to the predetermined number of rubbers, each of such sections receiving the score for one rubber and the name of one of the players.

A Peculiar Patent Claim.—As an instance of peculiar claims, a recent patent, No. 998,156, for a blue vat dye, is interesting. The first of the claims of the patent reads: "The herein described new dyestuffs having *probably* the following general formula," followed by a formula; while the second claim reads: "The herein described new dyestuff having *probably* the formula," followed by the formula. The use of the word "probably" in the claims seems an unusual one, but possibly the invention was one difficult to define in conventional terms.

Metal Culverts.—There is considerable activity in metallic culverts, and Charles A. Foster of Portland, Ore., has patented, No. 997,382, a culvert structure having a number of culvert sections secured together side by side and in which a transversely corrugated base plate has upturned side flanges and an intermediate flange, and arched top members each engaging the intermediate flange and a corresponding side flange. Mr. Foster has also issued a culvert patent, No. 997,383, including a spiral form of abutment comprising a plurality of complementary corrugated plates which are flanged for connection with the culvert.

A New Knight Patent.—A German automobile paper contains a notice of a new Knight valveless or sleeve valve engine, whose novel feature appears to be in the arrangement of the inlet and outlet ports on the same side of the cylinder and in such position as to open both said ports into the head above the extreme working stroke of the engine. We are not aware of the issue of a United States patent for the improvement. The mere opening of both ports into the head appears to be shown in the English patent No. 16,289, of 1909, although in such patent the ports are located on opposite sides of the cylinder.

A Matter of Clothing.—Is there any reason why we Americans, admitted to be the most ingenious people in the world, should suffer as our men do in the summer season because of our unreasonable style of dress? Notice a group of men and women in summer; while the women are attired in their cotton or linen garments, the men will have on coats as warm as those worn by many women in the depth of winter. No one has as yet been able to devise or suggest any acceptable summer dress for men, who continue summer after summer to swelter in warm woolen garments. Is this not a fit subject for invention?

A Telephone Repeater.—William Anderson of Longdale, Okla., has patented No. 997,584, a telephone repeater, in which a repeater is in the telephone circuit and is automatically operative in either direction of transmission. The repeater includes two transmitters and two receivers and two inductoriums. The transmitters are connected with the primaries of the inductoriums, and the receivers being connected with each other are also connected with opposite secondaries of the inductoriums.

A Starting and Alighting Gear for Flying Machines.—Matthew B. Sellers of Baltimore, Md., who has given much time and thought to aviation, has just secured a patent, No. 997,860, for improvements in flying machine. The machine has a series of planes arranged in stepped form and yieldingly supported at their rear edges, and the chassis has both wheels and runners, the wheels being held in a relatively low position in starting by means including connections with the draft devices, and the wheels are automatically released and lifted after the machine leaves the ground and held elevated relatively to the runners, so the machine may run on the wheels in starting and will alight on the runners.

An Edison Phonograph Improvement.—Thomas A. Edison has in a patent, No. 996,625, provided a new phonograph reproducer seeking to avoid the friction of the stylus sliding over the record by making the stylus in the form of a roller or ball and rotatably supporting the ball so that it will press upon and roll along the record surface. The patent also provides a support for the stylus which enables it to rotate with a minimum amount of friction.

Legal Notes

Foreign Words as Trade-marks.—In passing upon the registrability of the Spanish word "Elegancia" as a trade-mark for wine, the Commissioner of Patents in *ex parte* Julius Wile, Sons & Company reiterates the well-settled doctrine that the foreign equivalent of a descriptive word is not registrable.

The Commissioner's Powers Defined.—In the case of Cosper v. Gold and Gold and Cosper v. Gold, the Court of Appeals of the District of Columbia has held that where in an interference involving more than two parties the Commissioner of Patents decides that one of the parties is not the first inventor, such decision is final, but is appealable to the Court of Appeals of the District of Columbia; also that where the Commissioner affirms a decision dissolving an interference on the ground that one of the parties thereto has no right to make the claims, the Commissioner had jurisdiction to enter an order that such party is not the first inventor.

Mandamus and the Commissioner.—The Supreme Court of the District of Columbia by Justice Barnard has just decided in the case of Lang v. Moore, Commissioner of Patents, that where a claim was finally rejected which was not identical with the claim presented, but which the Commis-

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Philadelphia, Pa., July 10, 1911.

Progress in Fire Protection

We are in receipt of a kind letter from the Rochester (N. Y.) Chamber of Commerce, by its President, Albert B. Eastwood, in which we are assured of the appreciation by that body "of your splendid editorial, entitled, 'Public Rising to Prevent Fires.'" * * * That the "Rochester Chamber of Commerce is by that editorial stimulated to carry on this work aggressively, not promiscuously, for the country at large, but for the results to be obtained within the limits of the City of Rochester.

"If our example will stimulate other communities to like activity, this stupendous fire waste can be somewhat checked."

We reproduce that letter in part as an instance of a popular uprising among the business interests all over the country to reduce our enormous fire losses, losses which the present year shows to be largely on the increase.

In connection with this subject we have just received, with the personal compliments of its author, F. W. Fitzpatrick, consulting architect, formerly of United States Service, etc., entitled, "Fire and Fire Losses," a handsome work most carefully prepared for instructive purposes.

Mr. Fitzpatrick says fire is the most dreaded of devastaters; "it has been used in war for discharging weapons, and in its crude state, so to speak, as an auxiliary which ranks with carnage and rapine.

"In the form of conflagrations, it has supplied some of the most spectacular and memorable and saddest events in history."

Mr. Fitzpatrick very properly puts the weight of his argument for fire prevention upon the fire-resisting construction of buildings.

In connection with that conclusion, which is practically unanimous among those who have made a study of the matter, we recently gave considerable time to an examination of the recent development of using drawn steel in the place of the interior wood work of dwelling and office buildings, and for interior furniture in both classes of buildings, and for interior railway car work.

To be frank about it, we were greatly astonished at the BEAUTY, STYLE AND FINISH OF THIS STEEL INTERIOR WORK, which is now in use aboard steamships for stateroom and other interior work, as well as in the other cases above mentioned.

This interior steel work cannot be detected by visible inspection. It so closely resembles the finest wood work, both in design, grain, rounded edges, and inlaid ornamentations, that the occupier of a room so fitted up would not suspect, were he not told, that he was not surrounded by the finest wood work producible.

Then, too, this steel interior work is used for practically every purpose—flooring excepted—fine or plain woods are used for.

Of course, it is fireproof, will not burn, and overcomes that complaint of fireproof building constructors who have said: "How can we make a building fireproof when its occupants fill it up with inflammable furniture?"

For window frames, doors and frames, wainscotting, walls and ceiling, and all interior work, this DRAWN STEEL IS MADE AS BEAUTIFUL AS THE FINEST CABINET FINISH OF THE BEST TROPICAL WOODS. And far more beautiful artistic work is possible in shaping this steel than could be worked out in wood.

In fact, artistic designs in this steel, as beautiful to-day as they are, in study and practice are in their infancy.

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The preceding excerpt can give but the faintest idea of the beauty and utility of the Dahlstrom Products.

We are the originators of this class of work and have developed drawn steel construction to its highest efficiency. The Dahlstrom Products are to be found in the structures exemplifying "fireproof reality" such as The Singer Building, New York; William Hunter High School, Philadelphia; First National Bank Building, Denver; Amicable Life Insurance Building, Waco, Texas; U. S. Battleships Florida and Utah, and so on.

"Buildings as They Should Be"

—a book, fully describes the Dahlstrom Products. To the interested a copy free for 6 cents postage.

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Every particle of material used in the manufacture of this pen is of the finest possible quality. No expense is spared, and each part is separately examined before it leaves the factory.

The patent "LADDER FEED" prevents flooding.

The "SCREW-DOWN CAP" prevents leaking.

May we send you illustrated price lists or a selection of pens through your dealer?

The Pen point is made of 14-Kt. Gold (Iridium pointed) and wears for years.

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Why Do You Keep That Corn

Why do you pare it, nurse it, protect it? Why let it torture you? Millions of people simply cover the corn with a little Blue-jay plaster. It is done in a jiffy. The pain ends instantly. In two days the corn comes out.

No pain, no soreness, no inconvenience. No feeling whatever. All because of a bit of soft B & B wax. It loosens the corn while you simply forget it. In 48 hours the corn is gone.

These results are unfailing. They are guaranteed. Five million corns annually are removed in this way. Go get a package—stop that pain. It's folly to have corns.

A in the picture is the soft B & B wax. It loosens the corn.
B protects the corn, stopping the pain at once.
C wraps around the toe. It is narrowed to be comfortable.
D is rubber adhesive to fasten the plaster on.

Blue-jay Corn Plasters 15c and 25c per package

(7) Also Blue-jay Bunion Plasters. All Druggists Sell and Guarantee Them.

Sample Mailed Free.

Bauer & Black, Chicago and New York, Makers of Surgical Dressings, etc.

sioner decided did not differ in matter or substance therefrom, the Commissioner was exercising his judgment within the discretion and judgment and authority given him, and that the Court cannot in such case compel him to reverse such judgment, even if erroneous, by issuing a writ of mandamus.

The Conservation of Fishery Resources

(*Continued from page 152.*)

cial and other benefits of oyster culture, as contrasted with the primitive methods that formerly prevailed, should appeal to the few States that insist on doing nothing and are satisfied with letting their oystermen follow the same course that their grandfathers did, regardless of the depletion of the grounds and the neglect of the opportunity to reap large revenue from the sale or lease of barren or exhausted bottoms.

The valuable inshore sponge grounds on the Florida coast long ago became exhausted, and the fishermen were obliged to extend their operations into deeper and deeper water. This condition was brought about by the activity of the operations, the demand for sponges, and the indifference of the State. To make bad matters worse, a new destructive element was introduced into the fishery at the most inopportune time for the conservation of the sponge supply. The decline of the sponge fisheries in the Mediterranean Sea, and the interdiction of the use of diving apparatus in some parts of the sea, threw many spongers out of business and resulted in a great influx of Greek divers to the Florida coast. These people have shown no regard for the ultimate welfare of the fishery, and have not hesitated to violate a Federal law for the protection of the industry, so that the present outlook is grave.

In order to make possible the re-establishment of sponges on depleted grounds as well as to encourage the raising of sponges as a private enterprise, the Bureau of Fisheries has devised a method of growing sponges from cuttings that is susceptible of commercial application and should be extensively availed of when the State grants to sponge cultivators the proper measure of protection.

The Decline of the Lobster.

In spite of the most active possible hatching operations conducted by the Federal Government at three stations on the New England coast, and notwithstanding perennial attention from the State legislatures, the lobster has declined to an extent that causes much concern among those most interested in the welfare of the fisheries. This most valuable of our crustaceans reached the climax of its importance in 1889 or 1890, since which time there has been no interruption to the annually diminishing catch, while the price has steadily advanced. The immediate cause of the decline was the absolute disregard of the lobster fishermen for the welfare of the species. There is no set of fishing laws that has been more systematically, ruthlessly, and unanimously violated than those designed to protect short lobsters and egg-bearing lobsters. These laws have been admirably conceived, execrably enforced. There is scarcely a hotel or boarding-house on the entire New England coast that has not had illegal dealings with the lobster fishermen. I have personal knowledge of a State fishery official who encouraged lobster fishermen to bring him short lobsters for his table. I have heard of a United States senator who secretly bought lobsters illegally caught.

Water Pollution.

One of the strongest anti-conservation agencies is the pollution of water by industrial wastes. In thousands of localities insignificant factories or mills have been permitted, if not encouraged, to discharge their refuse into a stream, thereby polluting not only the immediate vicinity but many miles below, and driving out or killing every living thing. What can compensate a community for the fouling of the waters and banks of a beautiful stream or lake? In the long run, a trout or bass stream is of far greater value to a neighborhood than is a mill that pours noxious substances into that stream. This is of course true in the æsthetic sense, but it is equally true of the material aspects, for a properly administered fishing stream is a perpetual source of wealth, food, and recreation to a community. Industrial establishments can and should be conducted without injury to the fishes and other inhabitants of the water-courses on which located. Some of the States have fully recognized this, and have enacted and enforced anti-pollution laws without harm to legitimate business interests; but there is still need for a country-wide crusade against the desecration of public waters and the senseless destruction of useful aquatic creatures.

The Alaskan Fur Seals.

When the Pribilof Islands came into the possession of the United States in 1867 as a part of Alaska, the fur seals thereon, it has been variously computed, numbered from 2,000,000 to 7,000,000, with 4,000,000 as a safe estimate. At the close of the season of 1910 the herd consisted of less than 135,000 seals of all ages. During this entire period the government exercised absolute jurisdiction over the herd while on land, and partial jurisdiction while in the water, and it is therefore the opinion of many people that the government is responsible for the present precarious condition of the herd. This, however, is true only to the extent that the government failed to secure international agreements by which the seals would have received adequate protection while at sea.

It is now universally appreciated that the decline of the fur-seal herd was coincident with and dependent on hunting at sea. The early efforts of the United States government to prevent pelagic sealing in Bering Sea culminated in the arbitration proceedings at Paris in 1893. The award of the arbitration court was against the United States in both of the main contentions, namely, that Bering Sea is a closed sea and that the property right in the seal herd warranted the government in protecting the seals while on the high seas. Since the award of the Paris tribunal, the case of the fur-seal herd has gone from bad to worse.

Pelagic sealing is a cruel, wasteful, wholly unjustifiable business that can only be prosecuted in flagrant disregard for or indifference to the question of the perpetuation of the fur seal as a commercial animal. The preponderance of the pelagic catch consists of pregnant mother seals which have left their nursing pups on shore and gone to sea to feed. The killing of every cow seal therefore involves the loss of her unborn offspring and her pup on shore, which inevitably succumbs to lingering starvation, to say nothing of the cow's potential productivity, which may extend over a period of ten years or more. In all of its aspects pelagic sealing is repugnant to one's sense of decency and propriety. Our interests are largest and we have suffered most, but Japan and Russia have also had their herds depleted and almost wiped out by foreign or domestic hunters and raiders.

Notwithstanding that only a remnant of the once mighty fur-seal hosts is left, it is believed that the outlook for the preservation and restoration of the herd is more propitious than at any previous time. This optimistic view is based on the facts that the administration of the seal islands has recently been vested in the Bureau of Fisheries, where the fur-seal service logically belongs, and where it should have been years ago; that the seals are now receiving what they never before had, namely, continuous scientific supervision on which the conduct of the commercial features of the business will depend; and that under the authority and direction of an enlightened Secretary of Commerce and Labor the affairs of the seal islands will continue to be conducted with regard for both seal herd and government, whose interests are necessarily identical.

The most important augury for a new and improved dispensation for the fur seals is afforded by the treaty recently concluded between the United States, Great Britain, Japan, and Russia, by the terms of which the killing of seals on land will be continued at the discretion of the respective governments that are custodians of the seal herds while all pelagic sealing will be prohibited for at least fifteen years—and let us hope forever.

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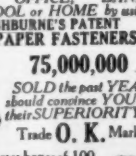

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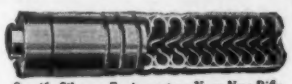

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Photographs in Railway Work

THE uses of photography are constantly extending. A western railroad has uses for it as a substitute for written reports on construction work. For example, the progress of the work of changing a grade crossing or building a bridge is photographed at stated periods, and the photographs are preserved both as a record and as illustrations of method. Pictures are also taken of all the resources of the road in the way of material, and of every mile of track, showing curves, grades, switches and crossings. A complete set of photographs is used, too, to illustrate the book of rules which is placed in the hands of every railroad man. This enables the men to refresh their memories by reference to the view of any particular point on the road, and makes them more readily interchangeable from one division to another. The book of rules also contains photographs of trains in more than one hundred combinations of circumstances, and the text informs the trainmen what to do in each case.

The "Talking" Picture and the Drama

By Robert Grau

IT was my pleasure to be among those in the audience at Keith's Union Square Theater, in New York, one evening in July, 1894, the eventful night when the motion picture was first revealed to American theatergoers. It is true that an inferior device under the name of Eidoloscope had previously made a feeble effort to introduce, also in a Keith theater (in Philadelphia), the effects which were destined ultimately to change the theatrical map, and to create the most lucrative field of endeavor in the history of public entertaining.

The advent of Lumière's cinematograph was announced with much advance advertising, but public interest was not aroused. The theater was only fairly filled on the opening night, but an idea may be had of the success from the fact that the theater which had, up to this time, played to average weekly receipts of about $3,000, found its "takings" increased within a single month to the unprecedented average of $7,000 a week, though the cost to the management was probably not over $100 a week for the machine itself.

Inside of a year the cinematograph was installed in every vaudeville theater in America, and hundreds of new establishments came into being. Thus was inaugurated the vaudeville craze which, as it progressed, brought into being many new devices, such as the Biograph and the Vitagraph. In a few years, no theater was without its machine.

In 1902 the "store" theater came into existence, and of these there were at one time nearly 30,000 in this country. New York city had more than 600 alone. An illustration of the vogue of the motion picture is best shown by the statement that one of the earliest endeavorers in this field, Marcus Loew, started in the Harlem district, about five years ago. Today this man is immensely rich. He has about forty theaters of his own, the majority of which are of the first class, such as the American, Plaza, Majestic, Yorkville, and Lincoln Square theaters, in New York. Hardly a week goes by that Mr. Loew does not add a theater to his list. He has now in the course of erection two magnificent amusement places, involving a cost of nearly a million dollars.

About four years ago William Fox, a man yet in his early thirties, opened the first "store" theater in Brooklyn; his success was so great that within a year he had a dozen similar resorts, where moving pictures were the sole attraction. In 1907 this man bought the lease of the Dewey Theater, on East Fourteenth Street, paying a rental of $50,000 a year. He then secured the Gotham Theater, in Harlem, the Star Theater, on Lexington Avenue, and the Family Theater, on One Hundred and Twenty-fifth Street. He also has several theaters in Brooklyn. Despite the enormous rentals and the low price of admission, Mr. Fox has made a fortune in the short space of four years, and last year amazed his colleagues by leasing the Academy of Music, paying a rental of $100,000 a year for a building which cost its owners but three times as much.

Although Messrs. Keith and Proctor have seven theaters of costly construction in Greater New York, but one of these, the Fifth Avenue, is used for the type of vaudeville for which they are supposed to stand; all the rest, including the Union Square Theater, where the cinematograph was first seen, have reverted to the camera man, and Mr. Proctor has a score of theaters in the smaller cities, besides those in which he is affiliated with Mr. Keith.

For several years the various manufacturers of films have been sorely tried to keep up with the demands for new subjects. The public patronage has grown to such an extent that millions of new theatergoers have been created. To hold this patronage and prevent its being absorbed by the regular theaters, has been the aim of all concerned in this vast industry.

Some of the world's greatest players have posed for the film makers, many of whom have stock companies under the direction of famous stage directors and producers.

For several years efforts have been made to create a perfect synchronism between the moving picture and the phonograph, in order that stage presentations of plays and operas could be reproduced.

The spectacle has already been presented of a famous stage idol, appearing in a theater of high prices of admission, while but a stone's throw away a perfect counterfeit presentation both as to voice and action could be seen for five cents.

Three of the greatest factors in the field of motion photography, including Thomas A. Edison, who invented also the phonograph, have announced recently that all of the problems for an absolute synchronism were either solved, or near solution. Mr. Edison has prophesied that the day is near when the working man will present himself in front of a moving picture theater, deposit his dime, and witness a reproduction of scenes from grand opera, such as are presented at the Metropolitan Opera House in New York.

I have already been privileged to hear and see almost an entire act of Donizetti's "Lucia de Lammermoor," including the famous sextette, as sung by Caruso, Sembrich, Plançon and others. Although perfection has not yet been achieved, no great wrench of the imagination is necessary, in order to predict that another year or two at most will witness the attainment of absolute synchronism.

The serious side of this situation lies in the ultimate fate of the player and singer, and by the same token of the manager and producer.

We know that Caruso has earned almost as much money from the preservation of his vocal records as in grand opera. Yet, there are those who have deplored the fact that the penalty is being paid in a slight deterioration in the illustrious Italian's voice.

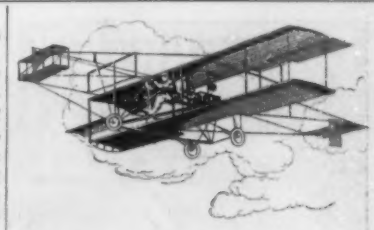
I yield to no one in my appreciation of the benefits to be derived from the phonograph, and have often wished that it had come into being in time to have preserved the voices of Malibran, Jenny Lind and Adelina Patti, in her prime.

But if even one year less of Caruso is the penalty which music lovers will have to pay in order that future generations may have preserved for them his vocal records, this price is hard to yield to.

It will be of interest to the reader to learn that in Paris such eminent celebrities as Mme. Bernhardt, Jane Hading, Mme. Réjane, and Mounet-Sully have been induced to pose for the moving picture camera. One French firm pays fabulous sums, in order that it may raise the level of its achievements.

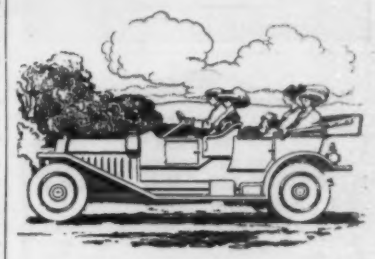
The possibilities of a perfect synchronism in effect of the two great Edison devices (for it must be understood that it was Edison who made possible the motion picture of to-day) are beyond all conception. Through this great advancement, the "Passion Play," as presented at Oberammergau, could be brought to our doors, and that, too, at a not very distant date.

It is already on the cards to present before American audiences scenes from grand opera, as presented at the Grand Opera House, in Paris; Covent Garden, in London, and La Scala, in Milan. Thus grand opera novelties, which would probably not be heard in this country for



THE present development of aeroplane and "motors" for land and sea has been made possible by the gas engine.

The gas engine has been made practicable through the development of suitable fuel and lubricating oil.



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These lubricants cover the needs of every part of the car.

Send to our nearest agency for "Polarine Pointers" which includes hints on the care of motor cars.

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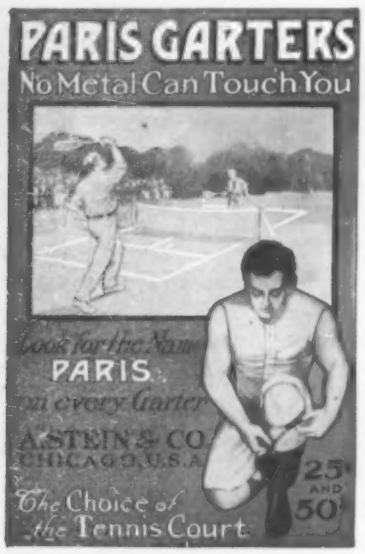

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DIVINE WATER MOTOR CO
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years, will have presentations within the year of their European *premieres*; also the great Kiralfy spectacles are now being reproduced, in order that the tremendous barrier of transporting to America over 1,000 persons may be overcome.

The film companies are capitalized in the millions, and there is not the slightest indication that any retrograde movement in this field will be permitted.

The great problem which presents itself is the effect that modernism may have on the actual player and singer, but after all, it is the latter element which has made possible the great progress in the moving picture industry, for they are induced to accept the liberal payments offered.

Recently $50,000 was offered to Caruso for the sole right to take his vocal records, and this sum was merely a bonus for exclusive privileges. Mme. Adelina Patti, when in this country on her last tour, refused an offer of $100,000 for a similar privilege, and this, too, at a period in her career when she was no longer the Patti of old.

The writer believes that the motion picture theater of the future will be conducted on a far more important basis than that of the present. Already the "store" theater is passing away, and the tendency is to secure regular theaters. In all the larger cities, large and commodious establishments are being erected and millions of dollars of invested capital are available at every turn. The effect on the regular theaters has already been appalling. Two years ago the vast chain of theaters devoted to melodrama found their position untenable, and there are to-day less than a dozen of this class of amusement temples in operation. All have reverted to what is known as "pop" vaudeville, or else they are lying dormant.

In Philadelphia there are twoscore of handsome theaters, newly built, some costing as high as $500,000 each, and all created through the really tremendous expansion in the field whereof I write. The attendance is enormous. It is not too much to assert that 100,000 persons attend these theaters daily in the Quaker City. In Boston the situation is quite similar; while in the smaller cities a singular state of affairs has come about. In what are called "one-night stands" the moving picture has solved the problem of the local managers, who have not hesitated to cast the legitimate attractions to oblivion and turned their "opery" houses into "nickelodeons" and "bijou dreams." Heretofore, the local manager would get one or two companies a week for his public's entertainment, and he had a hard time to pay his way. To-day, by the simple process of installing a moving picture machine and engaging a few minor acts of vaudeville, he is able to entertain from two to three thousand persons each day, at an average price of admission of ten cents. The expenses are small; the profits are huge. I have in mind a little town near New York, with a population of 30,000. Up to two years ago it was impossible to attract a paying audience with anything. To-day the one theater available gives three performances daily! Hardly a week goes by that less than 60 per cent of the population does not enter this theater at least once; while it is an absolute normal condition to find as many as 1,000 persons waiting in the lobbies and on the sidewalks, at 9 P. M., for an exodus of the seated audience, so that they may enter and witness the second show.

The public created by all this procedure is constantly being educated and gradually becomes more exacting in its demands, hence the advent of the "talking" picture, with all the enhancement which it promises to bring, should result in a general uplift, together with much benefit to the masses who must naturally appreciate any effort which will make possible for them to see and hear for ten cents that which has heretofore cost from fifty cents to two dollars.

It remains yet to be seen how nearly science and artifice have served to duplicate the original interpretation in music and drama. Mr. Edison has promised that the counterfeit will be almost perfect.

Rubber Bath Sponges

NATURAL bath sponges are becoming scarce and attempts have been made to increase the production by artificial sponge culture. The increasing price of sponges has also led to the invention of artificial sponges made of vulcanized India rubber, which have been in the market for a number of years and are already very largely used. Until recently the method of producing these substitutes, which are remarkably similar to natural sponges in structure, remained the secret of a few German firms, and the efforts of foreign manufacturers to produce rubber sponges were fruitless. It has long been possible to make porous vulcanized rubber, but the imitation of the peculiar structure of the sponge and the production of pores and cavities of various sizes in communication with each other appeared impossible. This object is accomplished in the manufacture of rubber sponges, which is now carried on in other countries than Germany, in the following manner, according to an article in *Caoutchouc et Gutta-percha*. In the preparation of the rubber, certain volatile constituents are added which, in the process of vulcanization, inflate the rubber, producing an effect similar to that of yeast in bread. Usually a mixture of alcohol and amyl acetate is employed for this purpose. In order to prevent premature evaporation of these very volatile liquids, the rubber is first incorporated with the usual additions, sulphur, chalk, etc., and rolled out cold into thin sheets. These sheets are dipped in the mixture of alcohol and amyl acetate and passed again through the rollers. These operations of dipping and rolling are repeated ten or twelve times. The mass is then divided into pieces the size of the fist, which are saturated with a solution of Para rubber and wrapped tightly in silk paper. In this condition the pieces are placed in the vulcanizer, in which the pressure of the steam is allowed to rise to about one-half atmosphere in fifteen minutes, is held at this point for twenty minutes, then increased to two and one-half atmospheres and after twenty minutes more is allowed to sink to the pressure of the external air. The sponges are then taken from the vulcanizer, allowed to cool in the air, and washed and brushed in water in order to remove the silk paper. They are finally boiled in a two per cent solution of soda and cut up into pieces of the desired form and size. These rubber sponges cannot compete with the finer grades of natural sponges, but they form very good substitutes for the medium and coarser grades.

Summary of the Reclamation Projects

(Continued from page 158.)

been built, so that now, on many streams, no water escapes whatever, and the lower reaches of the river bed have been grown over with trees and vegetation. The reclamation work in this district is scattered over the States of Colorado, Kansas, Nebraska, South Dakota, Oklahoma, and southern Wyoming. In the valleys the rainfall varies from 6 to 16 inches; in the mountains above the project, it reaches as high as 30 and 40 inches. The value of the irrigated lands ranges from $75 to $100 per acre in the northerly projects, to $100 to $1,000 in the southern projects, much of this land having sold for $3 to $10 per acre before the projects were inaugurated. UNCOMPAHGRE PROJECT, COLORADO.—In the Uncompahgre Valley is a body of fine land of 150,000 acres, but the run-off of the Uncompahgre River is limited, and after settlement a succession of crop failures followed. It was found that the run-off of the Gunnison River in the adjoining valley was very large; hence arose the suggestion to tunnel the intervening mountain, and divert the Gunnison River into the Uncompahgre Valley. An attempt was made to do this, but the cost was too great. The Reclamation Service took hold of the work, and completed the tunnel, six miles in length, which has been in use now during the past two seasons. One hundred and forty thousand acres in the Uncompahgre Valley have now an assured water supply, which is to be augmented by building a reservoir on Taylor River, a tributary of the Gunnison. GRAND VALLEY PROJECT, COLORADO.—This project in Mesa County, western Colorado, is designed to irrigate the higher Mesa lands, which include the

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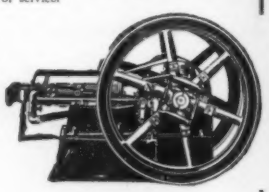

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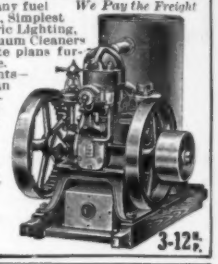

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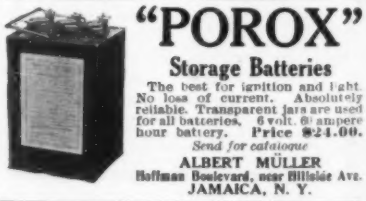
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best and most fertile country. The Reclamation Service has planned a canal which will furnish water to 60,000 acres of irrigable land from the flow of the Grand River. NORTH PLATTE PROJECT, WYOMING AND NEBRASKA.—One of the chief water courses in the Middle West is the North Platte River, heading in the high mountains of Colorado and flowing through Wyoming and Nebraska on its way to the Missouri. Although its flow is large during the spring months, it goes practically dry during the later summer months, and is generally limited in flow after July 1st. To conserve these waters, a large dam 218 feet in height has been built to form the Pathfinder Reservoir, which has a capacity of over a million acre-feet, and will irrigate some 350,000 acres in Wyoming and Nebraska. The first unit, comprising 117,000 acres, is nearing completion; the second, comprising 80,000 acres, will shortly be started, and the third is now under investigation. BELLE FOURCHE PROJECT, SOUTH DAKOTA.—Surrounding the Black Hills in South Dakota are situated numerous bodies of land of more or less limited areas, which would be fine farming land if there was sufficient moisture; but as the rainfall is below what is needed to produce crops, these areas are practically unoccupied and of very little value. The Belle Fourche Project, nearing completion, stores the water of the Belle Fourche River in a reservoir which will have a capacity of 200,000 acre-feet of water, and will conserve about 100,000 acres of irrigable land. The water is diverted into the reservoir from the river by a canal 70 feet wide and 10 feet deep. From the reservoir two large main canals carry the water to the land, from which lateral canals distribute it to the farms.

Brooks Comet of 1911

THIS comet, discovered by Dr. William R. Brooks at Smith Observatory, Geneva, N. Y., on July 20th, has been observed on every clear night by its discoverer, and at many other observatories throughout the world. On August 9th it was about seven degrees north of the star Beta in the constellation Pegasus, from which point the comet is moving northward about one degree daily.

Three of Prof. Brooks's previous comets have been found in Pegasus—he has discovered twenty-six comets in all—so that this constellation seems to be a favorite hunting ground for the Geneva astronomer. The following elements of this comet have been computed by Mr. Young and Miss Aitken at the Lick Observatory:

PERIHELION PASSAGE, OCTOBER 27TH, 1911.

	Deg.	Min.
Perihelion minus node	153	25
Longitude of node	292	53
Inclination of orbit	33	45
Perihelion distance		0.482

The comet is coming nearer and growing brighter, and promises to be an interesting object. It is now visible in a moderate-sized telescope, and will be observable for several months.

Motor Omnibuses in War

THE German military maneuvers this year will, as usual, possess many interesting features affecting modern warfare. It is anticipated that motor omnibuses will play a very great part in the maneuvers.

Each motor omnibus will be provided with room for fifty soldiers and possess a speed of about twenty-six kilometers an hour. This experiment was tried with a small portion of troops last year in Germany, and was found to work splendidly, the men being conveyed to the desired positions far quicker than if they had marched on foot, in addition to reaching their destination much fresher and readier for the work before them.

This year, when a long march is occurring, it is intended to use the motor omnibuses in conjunction with foot marches. The buses will convey a portion of the troops ahead, drop them at a certain point, whence they will continue their march, refreshed with the rest and the drive, and the buses will return to the main body for another load of soldiers, who will, in turn, be conveyed to the now advanced guard.

Costly Mining

IT might be said that in these days gold mining is about as expensive a way of making money as one could devise.

It is often necessary to put a fortune into the ground before one can begin to take out a bit of the gold. This is especially true of hydraulic mining. The largest hydraulic gold mine in the world is that in Trinity, California. There the owners are engaged in tearing away great sections of Oregon Mountain with immense streams of water. Now, to displace hundreds of tons of earth, and to roll immense boulders about as if they were marbles, requires, it is needless to add, a great force.

The operations at the Trinity mine extend over an area of between 2,000 and 3,000 acres. It was demonstrated from the first that gold was present in paying quantities in this mountain, but the difficulties in the way of getting at it were very great. There was no water available in the vicinity of the proposed mine, and water—a lot of it—was necessary. So it had to be brought through a pipe line from a point thirty miles away. A part of this line goes through a tunnel in the side of a mountain. This tunnel is a mile and a half long and its construction consumed a period of two years. The water is forced into a huge reservoir on the top of Oregon Mountain, and is conducted from this to the nozzles of the hydraulics.

From one of these nozzles a stream eight inches in diameter rushes out. The dislodged earth is carried through races and sluices prepared to receive it. Nearly 10,000 cubic yards of earth are turned into these sluices every day. Once a month the sluices are drained of the water, and the gold is gathered. Its weight carries it to the bottom of the heap. The gold obtained at these monthly intervals ranges from $15,000 to $40,000 in value.

As the mine is about fifty miles from a railroad, one can easily understand how great is the expense of transporting machinery and supplies. The cost of the tunnel and pipe line, too, was large; so that, before a dollar's worth of ore was taken from the mine, quite a fortune had been put into it. The present system is not much like that of the early days in California, when one or two men started out to seek a fortune armed with nothing but picks, shovels, and pans. The returns on mining investments in these days, although in some cases good, are no greater than in many manufacturing concerns.

Spiders' Threads in Astronomy

THE cultivation for scientific uses of certain species of spiders, solely for the fine threads they weave, has an important bearing upon astronomy.

No substitute for the spider's thread has yet been found for bisecting the screw of the micrometer used for determining the positions and motions of the stars. Not only because of the remarkable fineness of the threads are they valuable but because of their durable qualities.

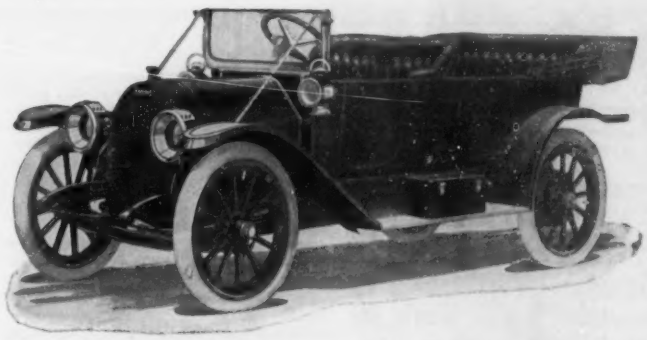
The threads of certain spiders raised for astronomical purposes withstand changes in temperature, so that often in measuring sun spots they are uninjured when the heat is so great that the lenses of the micrometer eyepieces are cracked.

These spider lines are only one-fifth to one-seventh of a thousandth of an inch in diameter, compared with which the threads of the silkworm are large and clumsy.

Turbine Water Meters

IN the *Revue de Mecanique*, Mr. Daries publishes a detailed monograph on turbine water meters, or so-called speed meters; these are somewhat less sensitive, but, on the other hand, cheaper than those of disk construction.

The turbine water meter consists essentially of a vertical shaft provided with blades, and contained in a chamber into which the water is admitted through oblique orifices. The momentum of the water sets the shaft rotating, and a system of toothed wheels connected to an indicator registers the number of turns.



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The 1912 Haynes is now ready for delivery. You can see the new models at our branches and agencies, or we shall be glad to send you a catalogue and name of nearest dealer.

SPECIFICATIONS HAYNES MODEL 21

Motor. 4 1-8 inch bore, 5 1-8 inch stroke, T-head Haynes type cylinders cast in pairs, offset 1-8 in. Flexible four point suspension.
Wheel Base. 120 inches.
Ignition. Eisman dual magneto, with dry cells for starting.
Carburetor. Stromberg 1 3-8 in., Model B.
Lubrication. Splash and force feed, oil reservoir in lower half of crank case and filled through bleeder pipe in center of crank-case.
Steering Column. Worm-and-gear type. Timken roller bearings on shaft, corrugated hard black rubber rim, aluminum spider, 18-in. wheel.
Clutch. Haynes contracting steel band on bronze drum. Supported by crank shaft. Easily adjusted and lubricated.
Transmission. Selective type, three speeds forward, one reverse. Timken roller bearings.
Rear Axle. Timken full floating type, pressed steel housing supporting full weight of car. Shaft, nickel steel.
Front Axle. Single piece I-beam 2 inch, drop forged. Spring seat forged integral. Spindles 5-16 inch diameter. Timken roller bearings.
Wheels. Artillery type wood, twelve spokes front and rear. Bposa spokes alternating in rear wheels.
Tires. 36 x 4 inch, front and rear. Demountable rims.
Springs. Front, semi-elliptic; 40 inches long, 2 inches wide, 7 leaves; rear, 44 1-2 inches long, 2 inches wide, 6 leaves. Fitted with grease cup, both front and rear.
Brakes. Internal and external on rear wheels. Drum 14 x 2 1-2 face.
Colors. Body black, 18 coats of paint, all hand rubbed. Wheels black same as body. All metal equipment, gun metal, black enamel and nickel.
Equipment. Eisman dual magneto Stromberg Model B Carburetor, silk mohair top, wind shield, Frost-O-Lite tank, five lamps, Warner 60-mile dial Speedometer, extra Dorian Demountable Rim, Tanner automatic gasoline gauge.

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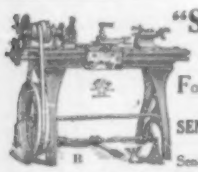

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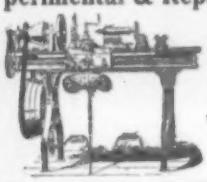

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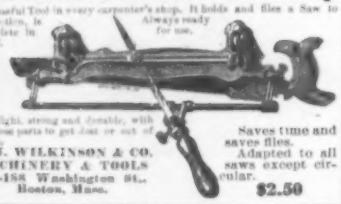

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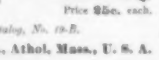

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(12511) W. T. H. writes: In your Answers to Correspondents, No. 12470, it is stated that steel is compressible at the rate of 68 millionths per atmosphere of pressure. I have the apparatus to make a simple test of the matter, a cylindrical tank, of sheet "tin," 12½ inches in diameter, with cone-shaped ends, having a capacity of about three cubic feet. The "tin" does not exceed 1/64 inch in thickness. My proposition was to pump 15 pounds per square inch air pressure into the tank and observe the increase in the girth when the pressure was on. I figured that if steel (or iron) was compressible (or extensible) at the rate mentioned, the girth of the tank should be 3/8 of an inch greater when the pressure was on. I made the experiment three times. The first time there was apparently an elongation of about 1/16 inch. The second and third times I used more care, keeping the tape measure in the same place and trying to strain it to the same tightness in all the measurements. In the two last trials there was no observable difference in the girth before and after the pressure was on. Of course extensibility is not compressibility, but I assume that they are about the same in amount, only in opposite directions. The experiment seems to indicate that there is no appreciable extension of iron with a tensile strain of nearly 7,000 pounds per square inch. A. A compression of 68 millionths in volume per atmosphere of pressure tells nothing of the deflection in one direction only under a strain. The co-efficient of elasticity of steel is 30,000,000, which means that one pound per square inch tensile stress will elongate the steel 1/30,000,000 of its length. Using the formula $pd = 2\ TS$ for your experiment, $15 \times 12\frac{1}{2} = 2 \times 1/64 \times S$ and $S = 6{,}000$ pounds per square inch on the cross-section of the trimmed iron, 1/64 inch thick. This would elongate the circumference of the tank 6,000/30,000,000, or 1/5,000 of its length around, equal to $\frac{12\frac{1}{2} \times 3.14}{5{,}000}$ or 0.00785 inch—too small to measure. Evidently the seam of the tank yielded in the first experiment, and after the lost motion was taken up you obtained no appreciable effect from the 15 pounds pressure again applied.

(12512) S. E. K. says: 1. Is there such a thing as "heat" lightning, or is all lightning "chain" lightning, and what we call heat lightning simply the reflection of a distant thunder storm on the clouds? A. The lightning called "heat lightning" is usually due to the reflection of a lightning flash below the horizon upon clouds above the horizon. It is too distant for one to hear the thunder from the flash. All lightning is not "chain" lightning. The real existence of "ball" lightning is now quite generally admitted by men of science. 2. When we see oblique rays apparently coming from the sun, is this really the action of the sun "drawing water," as the saying is? A. The appearance which is called "the sun drawing water" is caused by the sun's light passing through openings in the clouds and illuminating the particles in the air below, thus producing light stripes in the space below. The same may be seen sometimes after the sun has set, the stripes there being directed upward.

(12513) A. W. K. asks: Will you kindly inform me through your Question Column of a good formula for wet cells? A. There are four principal forms of wet cells; the one to be used depends upon the character of the service required. For interrupted, occasional work, such as bells, burglar alarms, and igniting gas and gasoline engines, the Leclanche cell is the best. Its solution is made by dissolving a quarter of a pound of ammonium chloride in water, enough for one cell. The Edison cell is also used for ignition and similar purposes. Its solution is a rather strong solution of caustic potash. The proper quantity is furnished with the cell. For a steady constant current, such as is required for electroplating, charging small storage cells, or for a telegraph battery, the gravity cell is the best. Its solution is a saturated solution of copper sulphate on the copper plates in the bottom of the jar with crystals of the same salt in excess to maintain saturation. And last, for giving a large current for a short time, such as for heating a wire, or for running a motor or working an induction coil for X-rays or a small wireless telegraph outfit, the best cell is the bichromate cell. The solution is a strong solution of bichromate of potash in sulphuric acid and water. The mode of preparing the solution as well as of making the battery is well described in SUPPLEMENT No. 792. A full description of all these cells is contained in SUPPLEMENT Nos. 157, 158, 159, which you should have if you need to use wet cells for any purpose. We will send the four papers for forty cents. Wet cells are not much used. The more convenient dry cell has taken their place. The dry cell is simply a Leclanche cell in which the solution is absorbed in some material so that it will not run out. The cell is then sealed to prevent evaporation.

(12514) E. F. B. says: Can you tell me approximately how many vibrations per second are required to produce a sound so high in pitch that it would be imperceptible to the average human ear? A. The average range of hearing is from 16 to about 40,000 vibrations per second. Some persons are not able to connect 16 vibrations per second into a continuous tone, and for some the inability to hear is below 40,000. This matter is tested by a Galton's whistle, which can be tuned up to more than 40,000 vibrations.

(12515) J. D. asks: A filled a drinking glass full of water, placed a piece of paper over the top, held it firmly, reversed the glass paper side down, then removed his hand from the paper; the paper remained in its place, and the water did not run out of the glass. A says it is due to the atmospheric pressure on the outside. B says it is vacuum and atmospheric pressure. Which is correct? A. The experiment you describe is explained by the surface tension of the water, which prevents the air from entering between the paper and the edge of the glass, and the atmospheric pressure, which holds the paper up and prevents it from dropping off the glass. It is not necessary to have the glass full of water. If only partly full, with air above the water, the experiment succeeds just as well. No vacuum is formed.

(12516) F. D. D. asks: The Nautical Almanac states that June 21st (astro. day) is the longest day of the year, being 15 hours 23 minutes (90 W. longitude, 43 N. latitude), but the earth does not reach aphelion until July 2nd, on which date the day is 5 minutes shorter than June 21st. I have always supposed that the axis of the earth tipped toward the sun to its greatest degree on June 21st, and consequently the earth must be at aphelion on that date. A. The sun is longest above the horizon on June 21st or 22nd, and hence this is the date of the longest daytime, or, as we term it in common speech, "the longest day." This is because the sun is then farthest north. It is vertically over the Tropic of Cancer, and makes the longest daytime in the northern hemisphere and the shortest daytime in the southern hemisphere. There are more degrees of the diurnal arc above our horizon in June than in January or any other month of the year in the northern hemisphere. This does not depend upon perihelion at all. The earth is in perihelion on January 1st to all parts of the earth alike, and in aphelion early in July. At perihelion the earth is traveling swiftest in its orbit, and at aphelion it is moving slowest. At perihelion the sun therefore makes more right ascension between noon and noon than at any other time of the year. For this reason the time from noon to noon is longest, more seconds, on January 1st. This you can easily verify by the Nautical Almanac. January 1st is the longest day, from noon to noon, in the year. From this you will see that the longest day is a very different idea from the longest daytime. The longest day nearly coincides with the shortest daytime in the northern hemisphere, but in the southern hemisphere the longest day and longest daytime are nearly coincident. The two are determined by different conditions, and are not dependent upon each other at all. The axis of the earth is for limited periods in positions parallel to itself. At the equinoxes, March and September, the sun is vertical over the equator, and the axis of the earth makes a right angle with the line joining the centers of the earth and the sun. At the summer solstice of the northern hemisphere in June, the earth's axis has come around apparently, so that its northern end is directed 23 degrees 30 minutes over toward the sun. The converse of this is true of the southern hemisphere at the same time. At the winter solstice of the northern hemisphere the axis of the earth has shifted 47 degrees from its position as referred to the sun from what it occupied at the summer solstice. A small globe, even an orange, and a lamp will enable you to demonstrate all this experimentally. It is nicely described in Todd's "New Astronomy," pages 150 to 160, a book which we send for $1.50 postpaid. Our circulation takes the SCIENTIFIC AMERICAN all over the world, and a description of these phenomena written for the northern hemisphere would be the reverse of true for the southern hemisphere.

(12517) R. J. G. asks: Does an exhaust fan create a vacuum when running at full speed? A. An exhaust fan creates a partial vacuum only. It cannot draw all the air out of a room or space. The very best mechanical air pump cannot do that.

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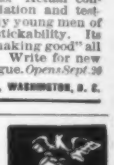

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NEW BOOKS, ETC.

HOME VEGETABLE GARDENING. By F. F. Rockwell. Philadelphia: The John C. Winston Company, 1911. 16mo.; 262 pp.; illustrated. Price, $1 net.

Instead of treating his subject in the usual encyclopedic manner, the author, himself a practical gardener, has endeavored to tell the man with a suburban lot how to put in a successful vegetable garden, and the things which such a man would wish to know are told in some kind of natural sequence, that the knowledge may be acquired and utilized to the greatest advantage. The area necessary for families of various sizes is given, the best way to apportion the space to the vegetables grown, and the varieties most easily and profitably raised, with the most approved methods of planting, cultivating, spraying, and fertilising. Fruits and berries are given considerable space, and a strong argument made for the growing of them. Sixty-four pages of illustrations brighten and improve the work. We note that the only index is by chapter headings. A detailed index would have been an appreciated and useful feature.

HAND BOOK OF GASOLINE AUTOMOBILES. New York: Association of Licensed Automobile Manufacturers.

This catalogue illustrates in the best possible style upon fine coated paper the machines made by those firms which make up the Association of Licensed Automobile Manufacturers. Touring cars, roadsters, runabouts, trucks, power wagons, every conceivable type of gas-propelled vehicle is here pictured with its specifications appended. This is the eighth annual announcement of the Association of Licensed Automobile Manufacturers, which now comprises seventy-nine makers and five importers.

THE ELEMENTS OF MACHINE WORK. By Robert H. Smith. Boston: Industrial Education Book Company, 1910. 8vo.; 192 pp.; 204 illustrations. Price, $2.

In the matter of text books our students of mathematics, physics and chemistry are better provided for than are our students in technical and trade schools and our shop apprentices. "The Elements of Machine Work" takes the learner through the processes of laying out work; chipping, filing, and scraping; hardening, tempering, and testing of steels; pipe fitting, soldering, and brazing; aligning shafting and installing machines. The treatment is condensed but none the less careful and eminently practical. Not technical students alone, but every youth who runs a lathe or uses tools as a hobby, may benefit by adding this text book to his working library.

THE GYROSCOPE. By V. E. Johnson, M.A. New York: Spon & Chamberlain, 1911. 12mo.; 52 pp. Price, 60 cents.

This is a brochure setting forth the principles and behavior of gyroscopic toys, from the spinning top to the monorail car. It abounds in instructive experiments, gives plans for the construction of a model car with various methods of drive and a special form of contact planes, and has a final word to say in behalf of other stabilizing systems and their probable utility in combination with the gyroscopic method.

QUESTIONS AND ANSWERS FOR AUTOMOBILE STUDENTS AND MECHANICS. By Thomas H. Russell, A.M., M.E. Chicago: The Charles C. Thompson Company, 1911. 8vo.; 140 pp.

The questions progress in logical order from basic principles and the main features of construction and operation to accessories, details, and varying methods. The catechism differs somewhat from most guides of similar form, in that the answer does not immediately follow the query. Instead, there is a chapter of numbered questions followed by a chapter of correspondingly numbered answers. This facilitates the use of the questions as a review test, yet places the answers within easy access in case of need. A drawback of the catechism is its entire lack of illustration. This somewhat unfits it for the use of the absolute novice unless supplementary works and diagrams are at hand. It is particularly designed, however, for school teaching, for the machine shop, or before the board of examining engineers. For any of these purposes it is well conceived and covers the field in a commendable manner.

MECHANICS FOR ENGINEERS. A Text-Book of Intermediate Standard. By Arthur Morley, M.Sc. New York: Longmans, Green & Co., 1910. 8vo.; 290 pp.; illustrated. Price, $1.20.

As a text-book, this is meant to fill a need brought about by the fact that the requirements of students in engineering are not identical with those of the student in general science. Since engineering students constitute a large proportion of the enrollment for mechanics classes in technical schools it is only right that they be provided with a course which recognizes their special needs. The author adheres to the gravitational system of units, defending it on practical grounds and pointing out that with proper premises it is just as rational as the "poundal" system which is confined to school work and must be discarded upon taking up practical problems in engineering. It is assumed that the reader is familiar with algebra to the progressions, the elements of trigonometry, and curve plotting. The calculus has not been used. The course laid down should easily be completed in a year.

INTRODUCTION TO GENERAL CHEMISTRY. By John Tappan Stoddard, Ph.D., New York: The Macmillan Company, 1910. 8vo.; 432 pp. Price, $1.60 net.

The information here given is graded and arranged with a view to its use as a first-year course in chemistry. The importance of sound reasoning from experimental results is recognized, and much of the work given is of a nature to induce in the student the true scientific attitude combined with enthusiasm and judgment. There are no pictorial illustrations, the writer arguing that the class room or laboratory furnishes sufficient concrete examples in apparatus, while confusion is apt to arise when the drawings of a text-book differ in general form or in detail from the actual experimental apparatus used.

GOOD ENGINEERING LITERATURE. What to Read and How to Write, With Suggestive Information on Allied Topics. By Harwood Frost. Chicago: Chicago Book Company, 1911. 8vo.; 422 pp.

Assuming that every engineer is sooner or later called upon to do some form of literary work, Mr. Frost essays to instruct the engineering fraternity in the art of written expression—in the preparation of reports, specifications and contracts, and of descriptive papers for technical societies and periodicals. A few rules in grammar and orthography are given, but the instruction is mainly confined to imparting such knowledge as will result in the clear and forcible description of works and ideas. The author is not only a successful maker of books himself, but was formerly editor of *The Engineering Digest*, and the work is full of the most condensed and valuable information which readers and writers of technical subjects would be benefited in learning. There are chapters on collecting and arranging material, on exercising the memory, on the preparation of manuscripts, the "field" and "policy" of technical journals, and "the making of a book."

POLAR EXPLORATION. By William S. Bruce, LL.D., F.R.S.E. New York: Henry Holt & Co., 1911. 12mo.; 256 pp. Price, 75 cents net.

There is a peculiar fascination about polar adventure that seems to be in inverse ratio to its rigors and loneliness. Dr. Bruce, with nine expeditions to his credit, recounts in simple, forcible English the facts of which keen and extended observation has made him master. He begins by stating astronomical facts that the reader should know—that the polar days and nights are each of six months duration; that it is always noon at the pole, whether light or dark, although there are alternations of seasons; that the sun describes an ascending spiral during one season, and a descending spiral at another. Having seen that the reader forms a right conception of these conditions, the author proceeds with description and comment until he has packed between the covers of his little book pictures of Arctic sea and ice, observations on coloration, and on plant and animal life, and thrilling incidents on ship and floe. Rich as the volume is in adventure, its chief claim to attention is in showing the aims of polar exploration in its relation to science and biology. A work of greater length and importance is promised.

THE EVOLUTION OF PLANTS. By Dunkinfield Henry Scott, M.A., LL.D., F.R.S. New York: Henry Holt & Co., 1911. 12mo.; 256 pp.; illustrated. Price, 75 cents net.

"The Evolution of Plants" is an attempt to tell "the story of the development of flowering plants, from the earliest geological times, unlocked from technical language." Dr. Scott re-states in brief the Darwinian theory, afterward dealing at considerable length with the problem and the evidence. There are chapters on the evolution of the seed plants, of the ferns, and of the higher spore plants. The story concludes with deductions drawn from the fossil record as compared with the organisms of existing plants, from the likeness between fern and seaweed, from the consistency between the thallus-theory and the fossil record, and with theories of a more general kind based upon the known facts. A few errors which have escaped the attention of the proofreader do not materially affect the popular value of the book.

SECOND COURSE IN ALGEBRA. By Herbert E. Hawkes, Ph.D., William A. Luby, A.B., and Frank C. Touton, Ph.B. New York: Ginn & Co., 1911. 12mo.; 264 pp.; illustrated. Price, 75 cents.

The course as laid out includes all the topics necessary for entrance to college, and is particularly adapted to students whose second year in mathematics has been devoted to geometry. The first part of the course is a very thorough review, leading up to the advanced material in which the best methods, new or old, are employed. Graphs are utilized in an ingenious manner in connection with logarithms, and all the exercises and problems aim to present new and varied material in an appealing way.

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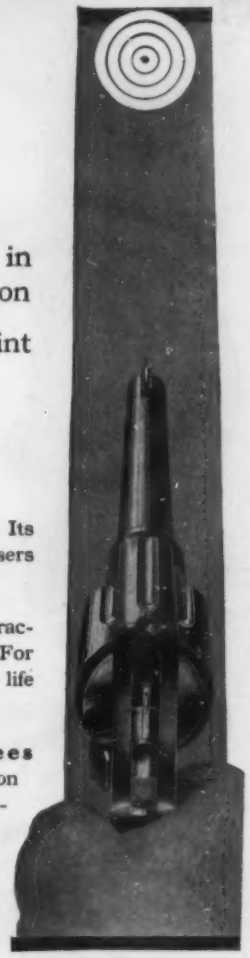

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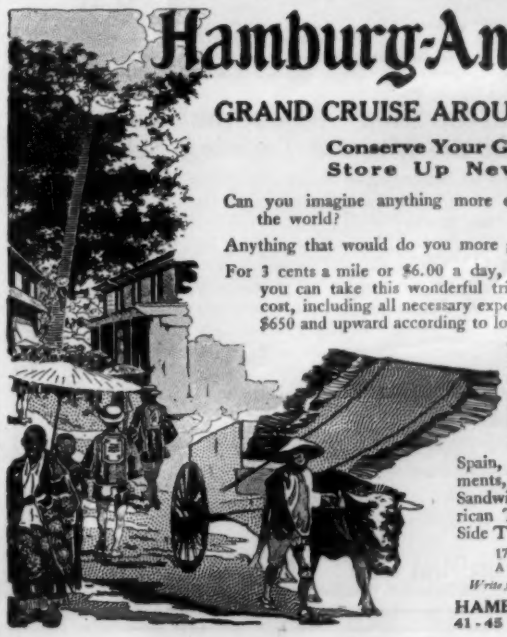

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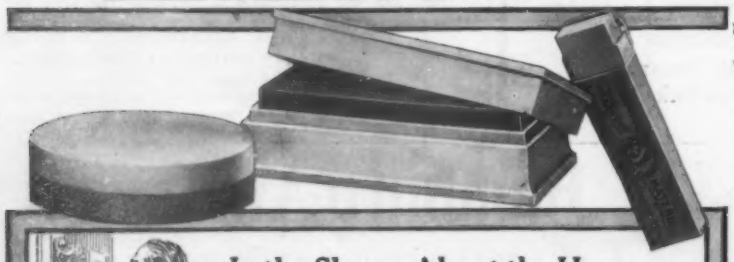

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Science

Return of Wolf's Comet.—We read in *Cosmos* that Prof. Max Wolf himself has re-located, on the 19th of June, the comet which is known by his name. Its position on that date at 12 h. 4 m. 9 s. (mean Koenigstuhl time) was R. A. 18 h. 46 m. 16 s. Dec. 13 deg. 28 m. N. The brightness was equal to that of a star of the fifteenth magnitude, so that the comet was just visible in large instruments. This periodical comet takes 6.823 years to complete its orbit. It passed its perihelion on May 4th, 1905, so that it is due to return there in the early months of 1912; its distance from the sun will then be 1.695 (refer to the earth's distance from the sun as unity); in aphelion the comet recedes to a distance of 5.599.

The Ivory Supply.—In view of the rapid disappearance of the herds of elephants which formerly roamed in Africa, and the limited number of those animals remaining in Asia, attention has been called to the enormous supply of ivory which exists in the frozen tundras of Siberia, and which, it is thought, will probably suffice for the world's consumption for many years to come. This ivory consists of the tusks of the extinct species of elephant called mammoths. The tusks of these animals were of great size, and are wonderfully abundant at some places in Siberia, where the frost has perfectly preserved them, and in many cases has preserved the flesh of the animals also.

The Intrinsic Light of the Stars.—According to *L'Astronomie*, M. Nordmann, of the Observatory of Paris, has made some interesting calculations of the intrinsic light of a number of stars, based on the results he had previously attained in regard to their effective temperatures. The brightness of a star, as seen from the earth, does not depend wholly upon its size and distance. Thus M. Nordmann finds that Sirius and Vega emit light the brightness of which is six million candle-power per square centimeter, while at the other end of the scale the light of Aldebaran amounts to only 22,000 candle-power per square centimeter. The intrinsic brightness of Vega is, according to this calculation, nineteen times that of the sun. If Vega were of the same size as Aldebaran and at the same distance from the earth, the former would appear to us over two hundred times as bright as the latter.

Queen Ants and Queen Bees.—It is claimed that the queen ant has not had justice done her by naturalists. As compared with the famous queen bee, she is regarded by Doctor William Morton Wheeler as a far more admirable creature. In fact, they are, in many important respects, diametrical opposites. The queen bee is, it is pointed out, a degenerate creature, unable to nourish either herself or her young, to visit flowers, to build combs, or to store them with honey. With the queen ant quite the reverse is true. She is held to be a perfect exemplar and embodiment of her species, and the worker ants suffer from incomplete and retarded development. The queen ant is a very industrious and intelligent worker, and, in the opinion of the authority mentioned, she forms an exceedingly interesting subject for study, and has not hitherto been well understood.

The Australian Antarctic Expedition.—Dr. Douglas Mawson, of the University of Adelaide, recently addressed the Royal Geographical Society, in London, outlining the plans of the expedition which will leave Australia under his command about the end of this year. The object is to explore the long stretch of coast known as Wilkes Land, lying between Cape Adare and Gaussberg (Kaiser Wilhelm II Land). Several parties will be landed at various points. The expedition is being recruited chiefly from graduates of the universities of Australia and New Zealand, and every member of the land parties will be a specialist in some branch of science. A visit to the south magnetic pole is part of the programme. From a geographical point of view this undertaking appears likely to yield the most interesting results of any of the Antarctic expeditions now projected or in the field.

Electricity

Electric Contact Device for Measuring Volumes.—Prof. Theodore Richards, says *Knowledge*, has employed a method of electrical contacts for measuring volumes very accurately. As the mercury is lowered so it can be set to just make or break an electrical contact consisting of a fine platinum point. He has used the method to determine differences in the compressibilities of liquids.

Sound Waves Produced by the Oscillatory Discharge.—The oscillating spark discharge produces sound waves which are not directly recognizable by the ear, owing to their high frequency. Their presence has, however, been demonstrated by Messrs. Campbell and Dye, as described in the *Electrician* by a modification of the well-known Kundt's dust tube. A glass tube closed at one end is placed in front of the spark gap, in such manner that the sound waves are reflected at the bottom of the tube, forming loops and nodes. In order to ascertain the position of these loops and nodes, a small amount of lycopodium powder is sprinkled in the tube, when it collects in small heaps at the nodes. In this way the experimenters ascertained the existence of sound vibrations of a frequency lying between 140,000 and 800,000 periods per second.

A Wireless Automobile.—A number of cadets from a military academy of the Northwest is now making a tour of about three thousand miles through the East and back to Chicago in four automobiles, whose engines drive the generators for the electricity of the wireless apparatus with which each machine is equipped and the machines are operated about thirty or forty miles apart, communication being maintained by means of the wireless. Each machine is provided with an extension mast, while balloons, also forming part of the equipment of each machine, can be utilized for carrying the antennæ wires to any desired height. The expedition anticipates visiting Washington, Annapolis, New York, West Point and other points of interest throughout the East.

Calibrating Tubes by Electric Resistance Measurement.—The measurement of resistance of a mercury column has been employed by T. R. Merton to calibrate capillary tubes, always a troublesome proceeding when done by measuring the change in length of a pellet of mercury. The English periodical *Knowledge* describes Mr. Merton's method as follows: The ends of the capillary tube communicate with two mercury cups which are connected to one arm of a Wheatstone's bridge. The mean radius r is given by $r^2 = \frac{1+2dr}{\pi\kappa f}$ where l is the length of the capillary, f the found resistance and d a correction for the stream lines at the ends of the capillary, κ the specific conductivity of mercury. It has occurred to the writer that measurements of volume in gas burettes might be made by inserting an iron resistance wire down the burette inside so that the mercury uncovers more or less of the wire as it is raised or lowered, the change in resistance of the wire being accurately measured.

Handling Iron Ore with Electric Magnets.—The *Electrical World* states that at Moose Mountain Mine in Ontario, Canada, high-grade magnetic iron ore is picked from the ground and loaded into cars by electro-magnets. The ferrous material found on the side of a hill is loosened and broken down by blasting, and rolls to the foot of the hill, where an electro-magnet, mounted on a crane, picks it up and loads it into mine cars, at the same time making a rough separation, since rock and non-magnetic material are left behind. The electro-magnet can handle 1,200 pounds of pig-iron at a load, but the magnetic quality of the unrefined ore is such that 800 pounds can be picked up easily. This is the average of a number of loads the individual lift sometimes being several hundred pounds greater. A steam shovel was formerly used for loading the ore, but the density and hardness of the magnetite destroyed the buckets rapidly. The electro-magnets also save handling a quantity of stone, and thus relieve the crushing and magnetic separating plant, where the material is concentrated before being shipped.

Industrial Chemistry

SEPTEMBER MAGAZINE NUMBER of the SCIENTIFIC AMERICAN

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In the September Mid-Month Number of the Scientific American the debt of humanity to the chemist will be set forth in simple language by men of highest authority.

No book of fairy tales ever told a story more amazing than that of modern industrial chemistry.

Nowadays the chemist-magician or the engineer-sorcerer evolves a palatable wine jelly out of old shoes, alcohol out of discarded shirts. Love letters are written on paper made from an old linen cuff, with ink that owes its origin to the rusty hoop of a beer barrel. The swish of a silken skirt is but the transformed rustle of a tree-top in the wind, for much silk is made nowadays from cellulose.

Undoubtedly the subject which is of most vital and personal interest to the American people is that branch of chemistry that deals with foods, drinks and drugs. At the time when the findings of Dr. Wiley had set the country astir, and the enforcement of the Pure Food and Drugs Act brought a storm of opposition from manufacturers involved, certain questions arose on which eminent authorities failed to agree. Accordingly President Roosevelt appointed a Board of scientific experts of the highest standing in the country as a supreme court whose decisions should be final and beyond further question. *Ira Remsen, President of Johns Hopkins University,* will tell us how this Referee Board, of which he is the Chairman, came to be appointed, explaining certain facts not generally known to the public.

America is such a young housewife that she has not yet learned the thrifty ways of her European neighbors. She is just beginning to learn that much of the stuff that formerly found its way into her garbage can is worth real money. What has, and may be done in utilizing our waste materials, will be told by *Robert Kennedy Duncan, Professor of Industrial Chemistry at the Universities of Kansas and Pittsburg.*

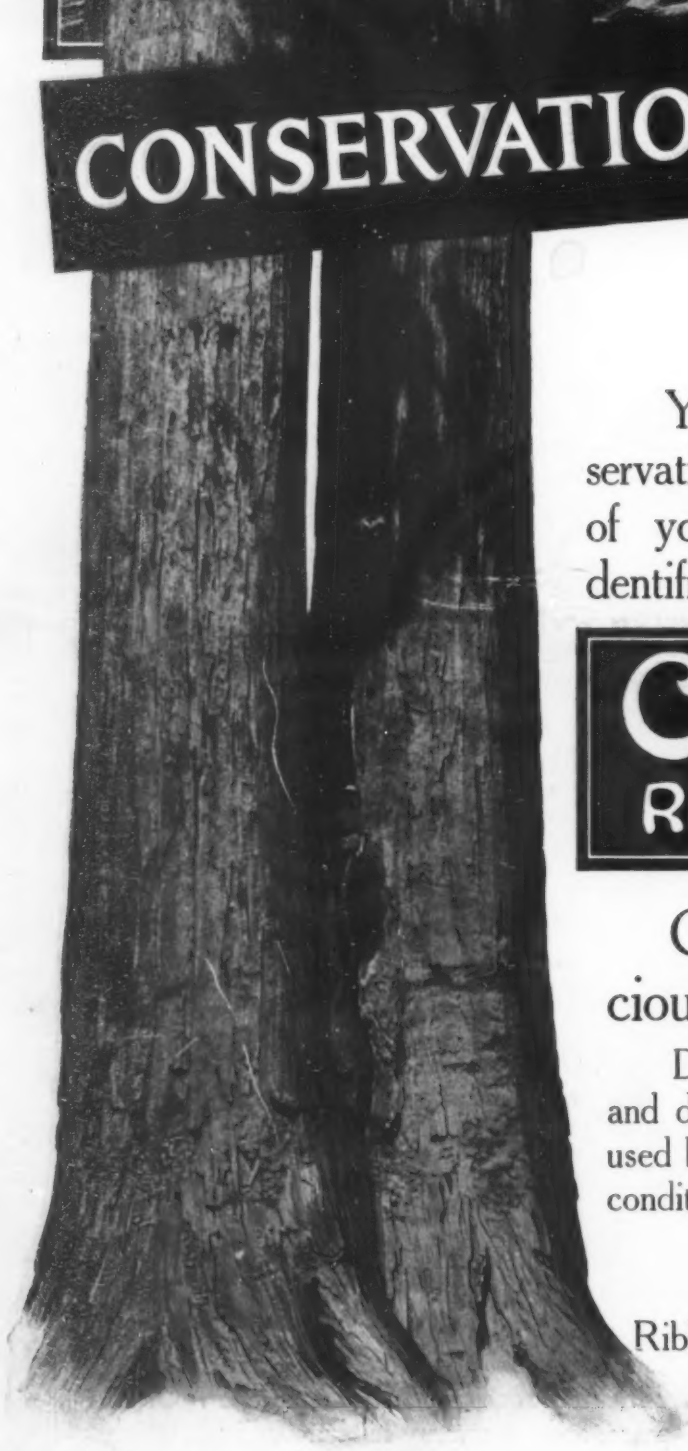
Not only have we been prone to throw away valuable matter, but we have shown a surprising laxity as buyers. We are now waking up to the fact that it is most important to make thorough chemical tests of raw materials. On this subject *Dr. Charles F. McKenna,* a leading expert, has prepared an interesting article.

Although we do not hold a very enviable position among the nations in the broad fields of chemical achievement, we may point with pride to our work in electrochemistry. Chemistry is magic, electricity miraculous. What these two mysterious forces may accomplish when working together makes a most engrossing chapter. *William H. Walker, Professor of Chemistry at the Massachusetts Institute of Technology,* has undertaken to write this narrative.

A very special work has been taken up by *Dr. Allen Rogers, of Pratt Institute.* He is going to explain how he trains men to become foremen in works employing chemical processes, thus making for intelligent co-operation in place of the ignorance and opposition with which the expert chemist has had so frequently to contend.

Our readers are probably familiar with the platinum sponge igniter for gas jets. The mere introduction of the little device into the stream of gas issuing from a burner causes the gas to burst into flame. We have here one of the infinitely numerous examples of so-called "contact action" or catalysis, a phenomenon which plays a most important rôle both in industrial work and also in vital processes. Of its significance, and the mystery still surrounding it, which modern science has as yet been unable to dispel, *Mr. A. J. Lotka,* writes in an article prepared specially for this mid-monthly issue.

In addition to the above articles, the September 16th number will contain the usual Editorial, Aviation, and other Departments.



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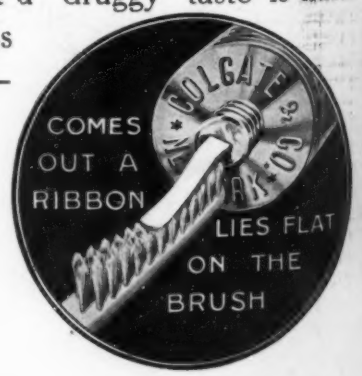

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